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REPORT
OF THE
GEOLOGICAL SURVEY
DEPARTMENT

FOR THE YEAR

1948

BY

F. T. INGHAM

Director, Geological Survey, Federation of Malaya

KUALA LUMPUR

PRINTED AT THE GOVERNMENT PRESS

By H. T. ROSS, GOVERNMENT PRINTER

1949

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FEDERATION OF MALAYA

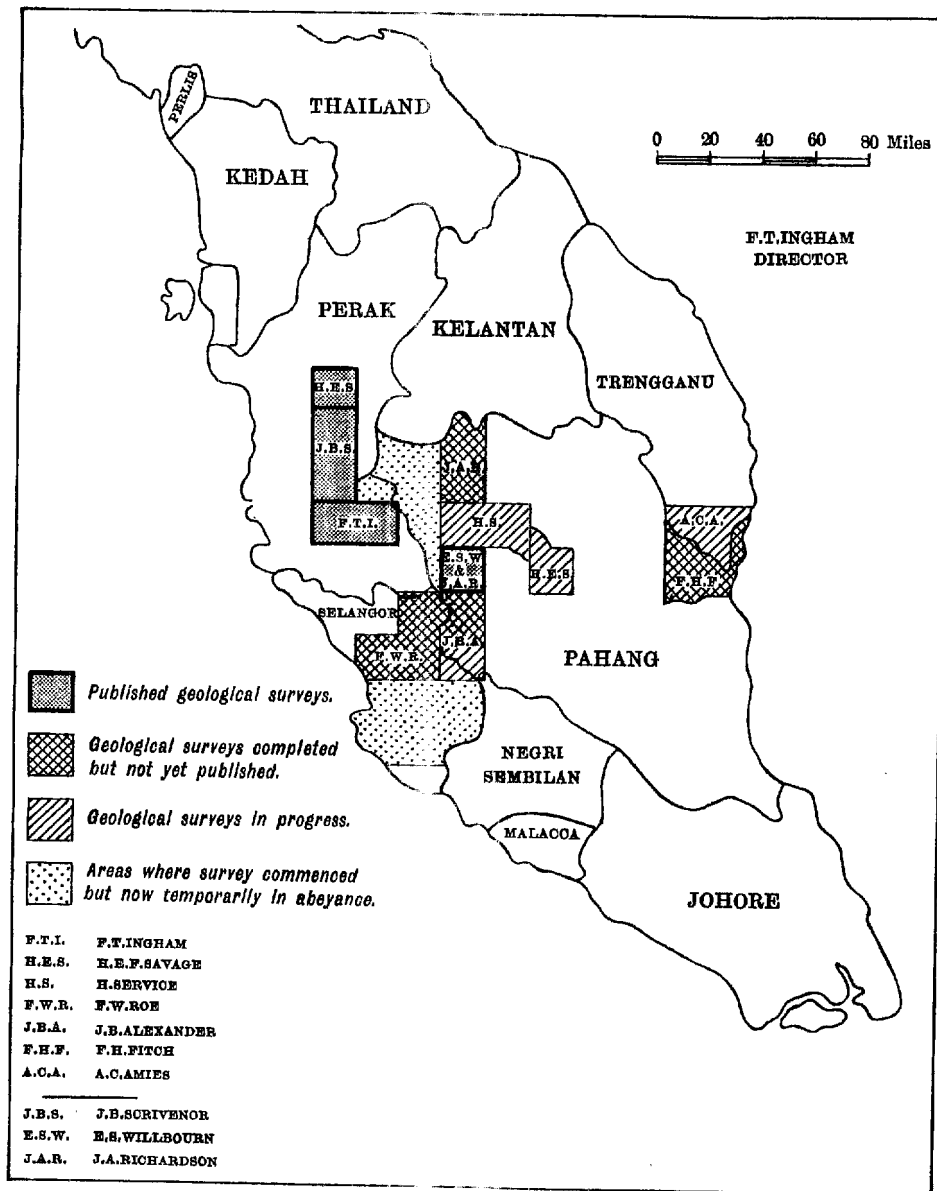
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1948 PROGRESS CHART OF DETAILED GEOLOGICAL SURVEYS
IN THE FEDERATION OF MALAYA



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REPORT OF THE GEOLOGICAL SURVEY DEPARTMENT FOR THE YEAR 1948.

STAFF.

1. Dr. F. T. Ingham returned from leave on 9th February and resumed his duties as Director. During June he accompanied the Director, Colonial Geological Surveys, to Borneo.

Mr. H. E. F. Savage, Geologist, on his return from leave on 28th July was stationed at Kuala Lipis.

Mr. H. Service, Geologist, acted as Director until 9th February, when he returned to Kuala Lipis. In October he was transferred to headquarters at Batu Gajah.

Mr. J. B. Alexander, Geologist, returned from study leave in America on 3rd November and resumed his duties at Bentong.

Mr. F. W. Roe, Geologist, continued his geological mapping of Northern Selangor.

Mr. F. H. Fitch, Geologist, was stationed at Kuantan throughout the year, but for three months was engaged in training Special Constabulary.

Mr. A. C. Amies was appointed Geologist and assumed duties in May. For two months he did full time work in the organization of Special Constabulary.

Mr. W. A. Tooke, Chemist, was on duty at headquarters throughout the year and Mr. G. M. Harral, Chemist, resumed duty on his return from leave on 17th October.

2. Mr. Savage, Geologist, carried out a refresher course of six weeks duration in mineralogy and micrography at the Royal School of Mines.

Mr. J. B. Alexander completed his course in Applied Geology at the California Institute of Technology, Pasadena.

Mr. G. M. Harral spent four months taking a course in Analytical Chemistry at the Royal College of Science.

Mr. Leong Pak Cheong, Senior Laboratory Assistant, completed his second year at Raffles College and passed the Intermediate Science Examination of London University as an External Student.

FUNCTIONS OF THE GEOLOGICAL SURVEY.

3. The main function of the Geological Survey is the promotion of the economic development of the mineral resources of Malaya. The first step towards this is the preparation of a general geological map of the country, as such provides the best means of contributing towards an understanding of the distribution and origin of the mineral deposits. A general reconnaissance survey has been made and a map published; this however contains many blanks and portions show colours based on surmises from the geology of adjacent country. Detailed geological mapping on the scale of one inch to one mile of known mineral fields and of selected areas previously covered by the reconnaissance survey is being carried out. As the greater part

of the country is under jungle, geological work of this nature is performed a slow and arduous undertaking. The progress chart forming a frontispiece to this report indicates those areas where surveys have been completed and those under survey.

4. Some revision of the regional maps of four of the States has been made possible in those areas where detailed geological survey work is in progress. These maps showing zones of (a) mining land, (b) potential mining land, (c) possible new mineral producing areas and (d) areas not likely to be required for mining, have been prepared for use of other Government departments. As the area covered by detailed geological surveys increases and more prospecting by Government and private companies is carried out, so will these regional maps become more accurate. The ultimate aim is to produce maps showing only land required for mining and that available for other purposes.

Other duties of the Department include the furnishing of reports to other Government departments and to the general public. Chemical work is mentioned in paragraph 167.

REVENUE.

5. The revenue collected in 1948 was as follows:

Assays for miners	...	...	\$5,816	as against	\$2,532	in 1947
Fees for reports and microscopic examinations	...	...	869	..	341	..
Sale of publications	...	...	190	..	568	..
Fees for copies of prospecting results	...	...	1,662	..	673	..
			\$8,537		\$4,114	

Since the arrival of chemicals and apparatus from England, the Chemical Laboratory has dealt with a large volume of departmental and external work. An unusually large number of requests for copies of prospecting results was received during the year and the revenue from the microscopic examinations of ores and "amangs" also showed an increase.

EXPENDITURE.

6. The actual and estimated expenditure for 1948 were as follows:

	Actual.	Estimated.
Personal Emoluments	\$83,014	\$74,201
Clerical Service	10,430	8,310
Other Charges, Annually Recurrent	47,414	65,100
Other Charges, Special Expenditure	25,862	31,435
	\$166,720	\$179,046

The expenditure on other charges, annually recurrent was lower than anticipated owing to the decrease in field work, brought about by the disturbed conditions during the latter half of the year.

REPORTS.

7. Several reports were furnished by the senior staff on geological aspects of certain engineering problems for the Public Works and the Electrical Departments, and memoranda were submitted upon potential water supply and irrigation schemes. Mining and commercial firms in Malaya were supplied with geological reports upon mining enterprises.

Reports on ore deposits or on the geological structure of mining propositions in the Federation of Malaya can be furnished on payment of a fee of sixty dollars for each day's field-work, and expenses charged in accordance with the Government's General Orders.

ASSAY FEES.

8. The Chemical and Geological Laboratories, besides carrying out free determinations for other Government departments, receive from the public samples for analysis for which the following charges are made:

(a) If the sample originates from the Federation of Malaya and a signed statement certifying the origin is supplied—

The determination of one of the following: tin, tungsten, gold, silver, lead, titanium or any other individual constituent, per sample	\$10
If more than two samples, up to four, sent together, per sample	8
Beyond the first four samples, up to a total of ten, per sample	6
Beyond the first ten samples, per sample	3
Mineralogical analyses, not entailing chemical analysis, maximum charge for one analysis	7
Screen analyses, per analysis	7
Proximate analyses of coal (moisture, volatile constituents, free carbon, ash, sulphur)	20
Complete analyses of mineral samples will be charged for according to the nature of the sample and the time necessary for the analysis, with a minimum charge of thirty dollars. An estimate will be given when possible.	

(b) If the sample originates from outside the Federation of Malaya the charge will be double the amounts given above.

PUBLICATIONS.

9. A revised edition (1948) of the Geological Map of Malaya on a scale 12 miles to an inch was published in June and is on sale to the public.

Mention must be made of the publication of a monograph entitled "Malayan Lower Carboniferous Fossils" by Dr. Helen Muir-Wood and other contributing members of the staff of the British Museum. This is the most detailed treatise on Malayan Palaeontology that has yet appeared.

A joint paper by Mr. J. B. Scrivenor, former Director, and Mr. F. H. Fitch on "Recent changes in Sea-level" has been prepared and will shortly be published in the Journal of the Royal Asiatic Society (Malayan Branch).

LECTURE.

10. A short paper on the investigation at the Klang Gates dam site was read by Mr. F. W. Roe to members of the Engineering Association of Malaya at Kuala Lumpur in September.

ENQUIRIES AND IDENTIFICATIONS.

11. Enquiries were answered about water supply, road metal, ballast and filtering media; also about metalliferous ores and economic minerals including bauxite, columbite, ilmenite, iron-ore, lignite, magnesian limestone, manganese, monazite, and stibnite as well as materials for the manufacture of cement and sands for moulding.

Several minerals and rocks were received for identification, a service provided free of charge if the specimen is from the Federation of Malaya, and its exact locality is disclosed.

12. Numerous Banka Drill bore-samples were examined in order to determine if bedrock had been reached or if there remained the possibility of the occurrence of tin-bearing alluvium at depths below those reached by the bores.

The number of concentrates and "amangs", submitted for examination for the determination of the approximate proportion of all minerals present, showed a marked increase.

Some of the samples were interesting mineralogically and some samples from Petaling, Selangor, showed pyrite in octahedral form, corundum, galena and stibnite.

A sample of "amang" from Gambang was examined by Dr. Davidson of the Geological Survey of Great Britain and found to contain about 60 per cent. of xenotime. Further investigation of the amount of this mineral available will be made.

13. "*Thorotungstite*".—During the year there was uncovered during mining operations on the property of Kramat Pulai Ltd., a small deposit of the mineral first described under the above name in the American Journal of Science Vol. XIII, No. 78 June, 1927. As specimens obtained this year gave no thorium radioactivity under the Geiger Muller counter the material obtained in 1927 was re-examined by Mr. W. A. Tooke, Chemist, who obtained an approximate analysis of WO_3 71 per cent., Rare earths 22 per cent., Water $5\frac{1}{2}$ per cent., and Insoluble material 2 per cent. As no thorium could be detected here Dr. Howling, Principal of the Mineral Resources Department, Imperial Institute, has examined specimens presented to that Institution in 1927 and has confirmed the presence of rare earths and the absence of thorium. It thus appears certain that the name "*thorotungstite*" is a misnomer. Further examination is being made by the Imperial Institute.

Two other minerals associated with the "*thorotungstite*" proved to be lead tungstate (possibly Stolzite) and iron tungstate. Further examination of these minerals is being carried out.

RECORDS OF PROSPECTING RESULTS.

14. Filing of the records of current prospecting results was continued and during the year 162 records were added. The collection now contains 3,209 files comprising 1921 records of prospecting in Perak, 642 in Selangor, 212 in Negri Sembilan, 302 in Pahang, 106 in Johore, 16 in Malacca, 3 in Kedah and Perlis, 5 in Trengganu and 2 in Kelantan.

15. Several firms who had lost their prospecting plans took the opportunity of having copies made from those in the central collection. Miners interested in any area should consult this central collection to see if it contains information useful to them. Prospecting results in State land cannot be disclosed until three months after the prospecting licence or permit has expired. Prospecting results in land reserved for any public purpose cannot be disclosed within a period of three months unless the consent of the officer in charge of the reserve and also of the prospector has been obtained. In the case of alienated land, results cannot

be disclosed within a period of three months after the termination of prospecting operations unless the consent of both the owner and the prospector has been obtained; when the three months period after prospecting has expired, it will be necessary to have the consent of the owner only.

16. In addition to making information concerning our mineral deposits easily accessible to Government and to the public, the collection helps to ensure that the maximum possible use is made of all the prospecting done in Malaya and that money is not wasted by any unnecessary repetition. The possessors of results obtained by prospecting in any of the former Unfederated States, and in the Federated States prior to 1924 or during 1941 are invited to lend them to the Geological Survey Department, and this request includes the prospecting done by mining companies on land already alienated for mining. In this latter case, the information is required in order to correlate the relationship between the occurrence of mineral deposits and geological conditions, for instance, the nature of bedrock.

17. Photostatic copies of the records contained in each file are now being prepared by the Survey Department for the use of the Mines Department. If the present rate of progress in this work can be maintained, within a short period each State headquarters of the Mines Department will be equipped with a full set of the available prospecting records for that State.

GEOLOGICAL COLLECTIONS FOR SCHOOLS AND OTHER INSTITUTIONS.

18. Representative collections of specimens of Malayan rocks and minerals were made for King Edward VII School, Taiping, and for the Army Education Centre No. 72, Kuala Lumpur.

ANNUAL CONFERENCE.

19. At the Annual Conference held in Batu Gajah from 8th to 27th November a comprehensive course of lectures and practical work were given to field assistants, laboratory assistants and rock collectors of the department. Twelve overseers of the Mines Department also attended the course. Prior to its commencement revision of all lectures was undertaken by senior officers, under the supervision of Mr. Service, and lectures were given by all officers. Mr. Savage prepared and gave series of elementary lectures in Malay to Malay speaking members of the staff. Mr. Fitch made additions to the teaching collections and commenced the re-arrangement, cataloguing and indexing of the Museum collections.

VISITORS.

20. Dr. F. Dixey, Director of Colonial Geological Surveys, visited Malaya from 15th-31st May. Accompanied by the Director he visited numerous mining areas including workings for bauxite in Malacca, the coal mine at Batu Arang, the Pahang Consolidated Company Limited property at Sungei Lembing, and the gold mine at Raub. Various tin mines showing different mining methods were also seen in both Selangor and Perak. A few days were spent at headquarters in Batu Gajah.

21. About seventy members of the Technical Association of Malaya visited the head office on 13th November and were shown various aspects of the geological work of the department by members of the staff.

Dr. (Mrs.) E. Alexander, who is carrying out geological work in Singapore, spent two days in the departmental laboratories.

BORNEO.

22. The Director accompanied Dr. Dixey on his visit to Borneo from 31st May to 25th June. The opportunity was taken of examining coal workings in Labuan and at Silantek, Sarawak, gold workings at Bau, Sarawak, oil wells at Seria, Brunei, and a proposed dam site at Tenom, North Borneo.

ACKNOWLEDGMENTS.

23. Officers of the Mines Department are thanked for reporting items of geological interest in mines and for donation of interesting mineral specimens. This assistance is particularly appreciated as only a small area of Malaya is under detailed examination by geologists and it is thus not possible that all mines showing features of geological interest can be visited by them without such reports being received. Most of the production figures in this report have been furnished by the Mines Department.

Specimens of tungsten minerals for the museum were presented by Mr. J. Weekley and the following minerals were also donated: tin-ore and wolfram by Mr. Ong Ghim Phoe; topaz crystals and cassiterite by Mr. S. Ramplen Jones; lead ore minerals by Mr. W. P. Harry. An elephant tooth obtained by mining from alluvium was presented by Mr. O. D. Paterson. Specimens of foraminiferous limestone from Borneo were donated by the Sarawak Oilfields Ltd.

Thanks are also due to Mr. E. S. Willbourn for books given to the library.

The assistance of identifying fossils by officers of the British Museum staff is greatly appreciated. The Mineral Department of the Imperial Institute has examined and reported on samples submitted to them and provided valuable information to the department.

NOTES ON THE MINERAL RESOURCES OF MALAYA BY F. T. INGHAM, DIRECTOR.

24. *Brief History of Mining in Malaya.*—When the mining of tin-ore and gold first commenced in Malaya is not known, but deposits were probably worked at the time when Cornish mining began. In the ninth century Arab writers refer to a place famous for its tin. Old gold workings in Pahang were in operation before the thirteenth century. Chinese have worked for tin-ore for several centuries and tin coinage was in use prior to the Portuguese occupation of Malacca in 1511. About that date from that port both tin and gold were being exported. Rich alluvial deposits in the Larut area were discovered about 1848 and rapid development of the area by Chinese eventuated, there being 40,000 Chinese working in that district by 1872. Faction fights between various clans of Chinese became so violent at that time that British intervention resulted.

25. *Geological Sketch.*—The oldest known rocks in Malaya belong to the Carboniferous system. They include schists and in places quartzites underlying a calcareous formation which although generally argillaceous, comprising shales and phyllites, in some parts of the country is represented by limestones and dolomitic limestones. A similar lithological facies in parts of Malaya was laid down during the Permian period. During the Triassic, beds predominantly arenaceous were deposited and these consist of quartzites, sandstones and conglomerates with some interbedded shales. Occurrences of chert are also known and these are generally associated with arenaceous rocks. During Carboniferous, Permian and Triassic times there was contemporaneous volcanic activity and lavas, tuffs and hypabyssal rocks are associated in many localities with the sediments.

In the late Mesozoic era, possibly late Cretaceous, the sediments were affected by mountain-building movements and crumpled into folds having a general north to south axial trend. Molten magma later to solidify into granite was injected into the cores of the anticlines. In adjoining areas sedimentary rocks were metamorphosed by the pressure and heat, shales being converted to schists and hornfels, sandstones to quartzites, and limestones to marbles.

Tin, tungsten, iron, lead and other minerals originally present in small quantities in the molten material, later forming granite, became concentrated in the residual hot liquid under pressure far down under the consolidated rock. Fissures were formed during the cooling and shrinking of the outer granite crust in both the outer layer of the granite and in the sedimentary rocks in contact with it. The residual liquid was forced into these cracks and was deposited in them forming lodes, veins and stringers.

An elevation of Malaya took place after the Triassic period and a prolonged period of erosion followed. In Tertiary times more sediments, some containing beds of coal, were deposited in a few isolated lakes. Subsequent erosion of the sediments and the granite cores has resulted in the deposition of alluvium along river valleys and in the low-lying country forming the coastal plain. The alluvium is in many places stanniferous and is the main source of the tin-ore produced.

26. The following notes deal with minerals of economic value in Malaya. Folded in the back pocket of this report is a map showing the distribution of the more important minerals.

BAUXITE (Aluminium Ore).

27. The existence of bauxite in Malaya only became known during recent years and mining of this mineral commenced in 1936. The mining operations were carried out by Japanese companies and the entire output was exported to Japan. Up to the present deposits have been worked only in Johore and Malacca but bauxite is probably of widespread occurrence and is known to occur in Pahang, Selangor and has been reported from Kedah and Trengganu.

Some of the deposits of commercial quality and size have resulted from the weathering of ancient volcanic rocks but others have been derived from sedimentary shales.

28. The export of bauxite (figures in long tons) prior to the war was as follows:

	1936.	1937.	1938.	1939.	1940.	1941 (10 months).
Bukit Pasir Mine, Batu Pahat	36	13,000	37,137	33,763	29,654	24,687
Sri Medan Mine, Batu Pahat	—	—	3,619	37,828	28,729	26,138
Perigi Achih Mine, Kim Kim	—	96	14,995	12,796	—	—
Total	36	13,096	55,751	84,387	58,383	50,825

Bulk assay figures for 1940 were 57-60 per cent. Al_2O_3 at the Bukit Pasir mine and between 55-58 per cent. Al_2O_3 at the Sri Medan mine.

29. During the Japanese occupation, production was increased and from the Bukit Pasir mine, between May, 1942, and December, 1944, approximately 150,000 tons were exported to Japan. No transport steamers were available after that date and operations ceased in March, 1945, a stock of about 30,000 tons remaining stacked on the mine. Two new mines were opened during the occupation period one in Malacca at Telok Mas and one, the Nangan Mine, in south-east Johore. At the former approximately 100,000 tons of ore were exported to Japan between August, 1943, and October, 1944, but lack of transport prevented further shipments. The ore from Telok Mas is stated to have assayed 52 per cent. Al_2O_3 , 4 per cent. SiO_2 , 1 per cent. TiO_2 and 10 per cent. Fe_2O_3 . About 70,000 tons of mined ore remained on the property. In south-east Johore near Pengarang the Nangan Mine was started to operate several deposits covering a large area in this neighbourhood and from this neighbourhood the Japanese hoped to produce 500,000 tons annually. Lack of machinery however prevented the area being developed and only 3,450 tons were shipped to Japan and 42,000 tons of mined ore left on the property. The ore was stated to average about 56 per cent. Al_2O_3 , 4 per cent. SiO_2 , 0.7-0.8 per cent. TiO_2 and 6.7 per cent. Fe_2O_3 . Further prospecting for bauxite has been carried out by private companies in this and other areas since the war and it is probable that the export of bauxite will recommence in the near future.

CHINA CLAY.

30. China clay (Kaolin) occurs in numerous localities throughout Malaya. At present the bulk of the small production is used for local needs as a filler in manufacture of rubber goods and in pottery making. Two mines are in operation one near Tapah, Perak, and the other near Pudu Ulu, Selangor.

Recent production figures are as follows:

1937. Tons.	1938. Tons.	1939. Tons.	1940. Tons.	1941. Tons.	1946. Tons.	1947. Tons.	1948. Tons.
263	385	493	408	930	246	1,003	923

Exports for the year 1941, 1947 and 1948 were 306, 111 and 133 tons respectively.

COAL.

31. Although coal in small amounts occurs at several places in Malaya only at Batu Arang, Selangor, are the deposits large enough to be worked on a commercial scale. Coal was first discovered here in 1908 and production commenced in 1915.

Approximately 12,616,000 tons of coal had been mined from this field up to end of 1948. The geology of the area is described in paragraph 103.

32. Production figures in long tons during recent years are as follows:

1939.	1940.	1941.	1942.	1943.	1944.	1945.	1946.	1947.	1948.
441,025	781,509	687,000	244,590	489,112	409,100	226,702	224,674	226,301	375,460

The coal has a typical analysis of:

Moisture ...	21 per cent.	As received	9,000 B.T.U.
Volatile matter ...	35 "	On dry basis	11,000 "
Fixed carbon ...	35 "	Dry free ash	
Ash ...	9 "	basis ...	13,000 "

GOLD.

33. The production of gold in Malaya, of great importance during the sixteenth century, has become almost insignificant during modern times being overshadowed by the discovery and exploitation of gold in South Africa, United States of America, Canada and Russia.

Gold in small quantities is of widespread occurrence in alluvium throughout the country but more especially in that belt of country to the east of the Main Range extending in a roughly north to south direction from the borders of Siam, through Kelantan, west Pahang and Negri Sembilan. Localities known to contain gold are coloured yellow on the map with this report.

34. During late years the bulk of the production has been obtained from the property of the Raub Australian Gold Mining Company in Pahang. There the gold occurs in veins filling steeply inclined fault fissures in "country" of calcareous shale, and is believed to be genetically related to the granite. The production of gold from this mine averaged over 25,000 ounces a year for the period from 1929 to 1940. Although other lode mines have been worked in the past in other parts of Pahang and in Negri Sembilan, it is now the only gold lode mine producing gold in Malaya.

In the Bidor area of Perak gold is obtained as a by-product from stanniferous alluvium and the gold output from this area reached a maximum of 8,356 ounces in 1940. Small quantities of gold are also won from alluvium in Kelantan, Johore and Malacca and a few hundred ounces are also recovered by tin dredging companies operating in Selangor.

35. Production of gold for the years 1928-1941 in ounces troy was as follows:

1928	18,693	1933	31,306	1938	40,795
1929	26,702	1934	32,822	1939	41,166
1930	29,597	1935	30,644	1940	36,198
1931	27,021	1936	38,610	*1941	30,087
1932	27,475	1937	34,653		*(10 months)

The property of the Raub Australian Gold Mining Company suffered extensive damage during the Japanese occupation but rehabilitation has been started and mining on a restricted scale commenced in 1947. The small production from Malaya since 1941 has been as follows:

1942	1,024 ozs.	1946	445 ozs.
1943	2,213 "	1947	5,312 "
1944	1,212 "	1948	10,216 "
1945	287 "		

ILMENITE.

36. Ilmenite, iron titanate, is the chief constituent of "amang", the heavy part of the waste material left after separation of tin-ore from the alluvial deposits of Northern and Central Malaya. Where magnetic separators are in use to dress the ore after preliminary concentration by water, the magnetic portion of the amang consists almost entirely of ilmenite. Large quantities of this mineral are present in the amang dumps of the numerous dredging companies throughout the country. Exports of ilmenite, the bulk of which is used in the manufacture of titanium white (the base of certain paints) and for special ferric alloys, began in 1935. Before the war the highest export figure recorded was in 1939 when 11,008 tons were exported, but exports were re-commenced in 1947 when 13,081 tons were sent abroad. Thirteen thousand five hundred and sixty-six tons were exported during 1948. Should a larger demand ensue the amount exported could be increased.

To be saleable the "amang" must contain over 48 per cent. TiO_2 , and the actual content of exported material usually varies between 50.8-61.40 per cent. TiO_2 with from 18-35 per cent. FeO and from 5-20 per cent. Fe_2O_3 .

IRON-ORE.

37. The principal deposits of iron-ore so far mined in Malaya occur in the States of Johore, Trengganu, Kelantan and Perak. Although some of the worked deposits, namely Sri Medan Mine, Johore, and Machang Stahun, Trengganu, were approaching exhaustion prior to the war, other occurrences of ore are known and in Ulu Rompin, Pahang, a deposit has been estimated to contain about thirty million tons.

Exports of iron-ore commenced in 1921 and increased to a maximum of nearly two million tons a year just prior to the outbreak of hostilities. The iron mining industry was entirely controlled by Japanese and all ore was exported to Japan.

The deposits which were worked and the figures of ore exported from 1937 to 1941 were as follows:

	1937.	1938.	1939.	1940.	1941. (10 months)
State of Johore—					
Sri Medan Mine,					
Batu Pahat	465,486	549,960	423,093	464,789	218,469
Iizuka Mine, Endau	—	—	239,772	160,891	146,358
State of Trengganu—					
Dungun Mine	1,024,215	905,316	905,850	998,892	680,275
Machang Stahun			161,052	142,325	
Kemaman					
State of Kelantan—					
Temangan Mine	49,223	159,900	208,820	228,252	154,697
Total	1,538,924	1,615,176	1,938,587	1,995,149	1,199,799

In addition to the above, iron-ore was obtained from Tambun, Perak, the bulk being used locally as ragging for jigs. Production from this deposit was:—1937, 1,147 tons; 1938, 923 tons; 1939, 768 tons; 1940, 975 tons; and 1941, 715 tons. Since the liberation 889 tons were obtained in 1947 and 641 tons in 1948.

38. Most of the ore consists of hematite, in places associated with martite but at Temangan limonite predominates. The iron percentage in the ores from Sri Medan averaged between 60-64 per cent., at the Iizuka Mine 55 per cent., at Dungun 62 per cent., at Machang Stahun 46-50 per cent. iron and 5-10 per cent. manganese and at Temangan about 56 per cent. iron.

During the Japanese occupation the Sri Medan and the Machang Stahun mines were closed down, partly owing to lack of ore resources and also because the machinery was required for mining bauxite. From the Dungun mine up to 1944 approximately 130,000 tons had been exported and about 800,000 tons stocked on mine. Some pig iron was produced there and also from ore at Tambun.

Since the liberation a new company to work the Dungun deposit has been formed and 70,000 tons of ore from earlier mining have been exported.

MANGANESE-ORE.

39. All manganese ore produced in Malaya has been worked by Japanese Companies. Export figures immediately prior to the war are as follows:

	1936. Tons.	1937. Tons.	1938. Tons.	1939. Tons.	1940. Tons.	1941. Tons. (10 months)
Machang Stahun Mine, Trengganu	26,773	23,126	23,054	19,900	8,400	Not available
Tandok Mine, Kelantan ...	10,006	8,796	8,916	11,100	11,895	6,268
	<u>36,779</u>	<u>31,922</u>	<u>31,970</u>	<u>31,000</u>	<u>20,295</u>	<u>6,268</u>

The Machang Stahun ore is a mixture of low grade hematite and low grade manganese-ore and carries from 5-10 per cent. manganese. The deposit was practically worked out by 1941.

The Tandok Mine near Gual Priok produced ore averaging about 37 per cent. manganese and approximately 1,000 tons were exported during the Japanese occupation.

No production of manganese has been made since the liberation. Other manganese deposits occur near the headwaters of the Sungei Aring, Kelantan, but lack of transport facilities has, up to the present, prevented these being worked.

TIN-ORE.

40. Malaya produces more tin-ore than any other country. About the beginning of the twentieth century half the world's production was from Malaya, prior to the war the proportion was approximately one-third. The tin occurs as cassiterite in veins and stockworks, both in granite and the nearby sedimentary rocks, also in pipes in limestone, especially near the granite contact. The bulk of the ore is however obtained from stanniferous alluvium, the Kinta valley being the major producer. Localities, showing where tin-ore occurs, are coloured red on the accompanying map. The various mining methods used in winning the ore comprise dredging, gravel pump mining, hydraulic, opencast mining, lode mining, lampanning and dulang washing. The bulk of production is however obtained from dredging although the largest underground tin mine in the world is at Sungei Lembing, Pahang.

As mentioned previously tin-ore has been mined in this country for many centuries and fairly reliable figures of production are available from 1898.

The mining of tin-ore was almost at a standstill at the end of the Japanese occupation but production, in spite of numerous difficulties, shows a rapid increase as can be seen from the following figures in long tons of production on a metallic-tin basis since the liberation.

1945.	1946.	1947.	1948.
3,152	8,432	27,026	44,815

TUNGSTEN-ORE.

41. The two ores of tungsten, wolfram (tungstate of iron and manganese) and scheelite (calcium tungstate) are both produced in Malaya. Since the closing down in 1939 of the Kramat Pulai mine, Perak, world famous producer of scheelite, exports of the latter mineral has become relatively unimportant.

The chief localities where wolfram is mined are Kedah (Bukit Kachi mine) and Trongganu (Chendrong Wolfram mine) but small quantities are obtained from mines producing tin-ore in Perak, Negri Sembilan, Selangor and Pahang.

The peak production of tungsten-ores was reached in 1936 when 1,639 tons of which 1,364 tons were scheelite, were obtained. The maximum production of wolfram was in 1918 when 1,382 tons were produced.

Since the liberation production has been small and figures in tons are as follows:

	1947.	1948.
Wolfram	33	46
Scheelite	11	29
	<hr/> 44	<hr/> 75

OTHER MINERALS.

42. In addition to those mentioned above there occur other minerals of possible economic value in Malaya, some of which have been worked on a small scale in the past and a few others which may become important in the future.

Arsenopyrite.—This mineral is of common occurrence in tin-bearing pipes in limestone. Some mines formerly condensed the arsenious oxide formed during the roasting of concentrates and this was sold to manufacturers of insecticides.

Chalcopyrite is an associated mineral in some tin lodes. Cement copper has been obtained from mine waters in the Pahang Consolidated Company's workings.

Cinnabar.—Although pebbles and fragments of cinnabar have been observed in the alluvium of streams draining into the Sungei Jelai, including tributaries of the Sungei Telom and Sungei Serau, no economic deposits have been found.

Columbite occurs in "amang" both in Kedah near Semiling and in Johore near Bakri. Analyses of columbite were given in last year's annual report. It is possible that production, started during the Japanese occupation, will recommence in the near future.

Corundum.—In Kinta there occur boulders and pebbles of corundum but unfortunately these are too scattered to be of economic importance.

Fluorspar used as a flux in certain metallurgic processes, was the main constituent of the Kramat Pulai scheelite ore body. No market for the crushed fluorite has been obtained.

Galena is of sporadic occurrence in many parts of Malaya. Small deposits have been worked in the Langkawi Islands, Perak and Pahang and are also known in Kelantan. Malayan galena is usually argentiferous but no large deposits have been discovered.

Graphite.—During the Japanese occupation graphite was mined near Chukai, Trengganu. The deposit is not considered sufficiently high grade to be worked profitably under peace-time conditions.

Mica.—Mica in small flakes was produced by the Japanese during the war from pegmatite dykes near Chenderiang, Perak and from Bakri, Johore. The occurrences would not produce material marketable under ordinary circumstances.

Monazite is of common occurrence associated with tin-ore in alluvium.

Xenotime is common in some amangs of the Gambang, Pahang area.

Zircon occurs mixed with ilmenite in amang and usually forms the major impurity in the non-magnetic fraction where magnetic separators are in use.

PROGRESS REPORT ON GEOLOGICAL WORK IN WEST CENTRAL PAHANG, BY H. E. F. SAVAGE, GEOLOGIST.

43. The writer was on leave at the beginning of the year and returned to Malaya on the 28th of July. The Kuala Lipis office was taken over from Mr. H. Service on the 26th of August, having been allocated field work covering Topo. sheets 2 O/14 and 3 C/2. These embrace country east and west of the railway line and Sungei Pahang from about five miles north of Kuala Tembeling southwards to Kuala Seboi, about three miles north of Kuala Krau.

It is to be regretted that the current political disturbances have prevented any field work which necessitates long journeys into the jungle. As conditions have from time to time permitted, day trips to points on the Benta-Jerantut road between the 46th and 55th miles have been made, and a three days' visit to the Jenderak area, west of the railway between the 98th and 102nd miles, was made in company with officers of the Department of Agriculture. Visits were also made to estates near Kuala Lipis, to the Raub Australian Gold Mines and to a gold mine in the Penjom area.

Close liaison was maintained with the Senior Inspector of Mines, Pahang (Mr. E. B. Thomas), whose ready co-operation and assistance are hereby acknowledged.

NOTES ON THE GEOLOGY OF THAT PART OF WEST
CENTRAL PAHANG COVERED BY TOPO. SHEET 3 C/2.

44. Numerous outcrops of Pahang volcanic series rocks are found on the Benta-Jerantut road, and those occurring between the 46th and 55th miles have been examined. In these exposures the series is predominantly represented by fragmental rocks, but lavas are also found, mainly andesite and trachy-andesite with some rhyolite and basalt.

The tuffs vary in grade from extremely fine-grained, argillaceous types in which there is a variable content of sedimentary mud, through silty and sandy varieties to normal tuffs and coarse agglomerates containing angular to subangular and sometimes rounded fragments.

The fragments are commonly of lava (usually andesite but sometimes rhyolite), shale, chert, quartz and quartzite. Occasional inclusions of granite, granophyre, micropegmatite, and microsyenite have been noted. Secondary calcite derived from associated calcareous sediments is generally common and frequently infills vesicles to give a tuff or basalt a spotted appearance. In one microsection an area of crystalline calcite was thought to be an inclusion of altered limestone.

45. In the field, to the naked eye, the fine-grained muddy or argillaceous tuffs are indistinguishable from weathered shales or mudstones, and the coarser, rhyolitic tuffs when weathered very closely resemble sandstone or weathered quartzite.

An extreme case occurs in an outcrop at the 49th mile, where what to all intents and purposes is an ordinary decomposed conglomerate of the Triassic Series, is found after microscopic examination in thin section to have a matrix of tuff. It is thought possible that some rocks in this area which in the past have been mapped as belonging to the (Triassic) arenaceous formation might actually be similarly obscure pyroclastic rocks and be more properly included in the calcareous formation (Carboniferous and ?Permian) along with the more straightforward and quite calcareous volcanic rocks with which they are associated and, apparently, interbedded. With an increase in the proportion of admixed sedimentary (or even rhyolitic quartzose) material some of these rocks simulate greywackes and, on microscopic examination alone, could justifiably be described as such; but the writer believes that their field relationship with a great thickness of undoubted volcanic rocks indicates that they are mainly of pyroclastic origin, and not purely aqueous sediments derived from the disintegration of pre-existent igneous rocks.

46. An interesting piece of co-operative field work was undertaken together with Dr. S. G. Willimott and Mr. J. Coulter, Senior Chemist and Chemist, respectively, of the Soils Division of the Department of Agriculture. A visit was made to Jenderak Estate, west of the 98th mile on the Pahang railway line, and the estate and the country to the north of it, that is: the basin of the Sungei Mai and its tributaries Sungei Relai, Sungei Baju and Sungei Juang, were examined. It was established that there is a quite direct and sometimes very pronounced relationship between the geology and the soils even within relatively restricted areas. It so happens that a great variety of rocks are found in this particular district and the change from one to another is invariably advertised by a change in the nature of the soil. Rocks occurring here include: Pahang Volcanic Series tuffs and lavas, quartz-monzonite-porphry, granophyre, fine-grained syenite, quartzite, shales and limestone.

47. A similar investigation was also made at a point on Jerantut Estate (53½ miles, Benta-Jerantut Road) over a bedrock of andesite-tuff. Syenite-porphry was also found on cropping nearby. There seems to be little doubt that the estate as a whole lies on country generally similar to that of the Sungei Mai area. This is to be expected because the trend of the formations and of the corresponding topography around the Sungei Mai is northerly, towards Jerantut Estate.

48. A hitherto unrecorded occurrence of massive limestone was noted during a rapid reconnaissance of Benta Estate (Topo. Sheet 2 N/16). The limestone is exposed in a number of places over a length of several hundred yards on the Sungei Amas, about three-quarters of a mile due west of the 12th milestone on the Kuala Lipis-Benta Road. Over much of the rest of the estate the country rocks are carbonaceous shales and mudstones with occasional interbedded rhyolitic and argillaceous tuffs of the Pahang Volcanic Series.

At the 8th mile, Kuala Lipis-Benta Road, soft, sandy and pebbly clays in a cutting are still recognisable as decomposed volcanic agglomerate.

HIGH LEVEL ALLUVIUM.

49. Incoherent but graded beds of sand, gravel and pebbles, identified as recent alluvium, occur in a number of cuttings between the 13th and 16th miles, Kuala Lipis-Benta Road. It is estimated that this alluvium lies at an altitude of about 250 feet above present sea-level.

FOSSILS.

50. In September, Mr. A. W. G. Abernethy of Budu Estate near Kuala Lipis reported the discovery of fossiliferous rocks on the estate, and with the co-operation of the Manager, Mr. H. R. Hayes, the writer spent many days examining the occurrence and making a representative collection of the fossils present, and these have been sent to the British Museum (Natural History) for identification. It is thought that the collection includes, amongst others, varieties of Cephalopoda [both straight and coiled (ammonoid) types], Productidae, and what appears to resemble giant Nummulinidae. From the structural features of the area the fossiliferous beds would appear to be stratigraphically intermediate between known Upper Triassic and Permian rocks, so their specific identification is awaited with keen interest.

51. A zone of Triassic fossils outcrops at the 1st mile, Kuala Lipis-Benta Road, and was recorded by Mr. H. Service at paragraph 126 of the Annual Report for 1946 (and earlier by Mr. J. B. Scrivenor, *vide* p. 64 of his "Geology of Malaya", 1931). What may probably prove to be an extension of this zone was found by the writer to be exposed in the hillside immediately behind the Geologist's office, which lies about ¼ mile south of the original discovery. A collection of material, believed to contain mostly *Myophoria* spp. and *Gervilia* spp. has been sent to the British Museum for identification.

In a specimen of coarsely crystalline limestone collected by Enche Abdullah bin Ismail from the Sungei Cheka (Topo. sheet 3 C/1) fossils have been noted.

MINING.

RAUB AUSTRALIAN GOLD MINES.

52. Towards the end of the year the opportunity was taken to visit the Raub Australian Gold Mines. Through the courtesy of the General Manager, Mr. F. L. Sanderson, the writer was enabled to examine cursorily the underground workings at the Raub Hole and Bukit Malacca mines. Mr. G. Everard, Geologist to the Company, acted as guide, explaining the layout of the mine and the nature of the country and the ore-deposits.

Since his arrival Mr. Everard has been able to identify as "marker beds" certain bands of calcareous breccia which accompany some of the lodes at Raub Hole. If further examination confirms that these "marker beds" are definite and persistent features identifiable as accompanying individual lodes, their discovery has an important potential value. It should help in the further elucidation of the structural geology of the area and make more certain the correlation of the lodes themselves.

RAUB TOWN BOARD AREA.

53. In October, during the preparation of the site for a new water reservoir for Raub Township, Mr. J. H. M. Burton, Executive Engineer, Public Works Department, Raub, observed tiny veinlets of free gold in vein-quartz dug out of a roadside drain. Samples of this quartz were assayed at the R.A.G.M. laboratory and reported to carry unusually rich gold values. The writer later examined the occurrence in company with Mr. E. O. Laird, District Officer, Raub, and Mr. Burton, but no more free gold visible to the naked eye or even discernible with a lens in any of the vein-quartz in the drain or the ground in its vicinity. A number of specimens were collected, crushed and panned and the concentrates from several were found to contain grains of free gold.

This gold-bearing vein-quartz occurs on ground worked between 1899 and 1902 by the South Raub Gold Mining Syndicate which closed down after a few years' work because of the poor value of the ground.

PENJOM.

54. A small opencast mine is being worked for gold by Teh Hon Yoon in the vicinity of the old "Penjom Gold Mine" (on Lot 1.622, M.L. 86) where there is a thin cover of alluvium in the hollows of undulating ground. The country rocks in the floor of the present mine-hole are: a porphyritic lava (or possibly a tuff) of trachyandesitic composition, overlain by a very fine-grained micaceous igneous rock also believed to be of volcanic origin. Associated with these and apparently lying above them is a rock which may be an indurated shale or another very fine-grained volcanic rock. Silicification and subsequent decomposition render microscopic identification of these rocks somewhat uncertain. The rocks are traversed by abundant thin quartz veins some of which carry pale greenish tourmaline. (The existence in this area of aplite—a fine-grained quartz-mica rock—has been recorded by earlier observers).

At present a depth of up to 20 feet of superficial material is being monitored, but only the upper portion of this is alluvium. The lower part is a clay formed by the decomposition of the country rocks, and presumably this clay as well as the alluvium carries gold (*vide* Annual Reports, 1939, para. 55 and 1946, para. 131). The question arises: if this is so, why is only the upper five to ten feet of the decomposed country rock worked? For, even if it is too tough for reduction by monitors, the decomposed rock lower down is yet soft enough to be dug and treated by hand tools. The answer probably is: that the gold-bearing veinlets are not abundant enough and the values in them are not high enough to cover the costs of hand treatment of the unavoidably large proportion of barren soft rock. The writer feels, however, that an experiment might be justified here, to ascertain:

- (a) if the bedrock, or part of it, actually does carry gold, in veinlets or otherwise;
- (b) if it is gold-bearing, could the soft rock that the monitors cannot reduce be treated by a combination of hand and hydraulic methods; for example: excavation by hand, milling by a simple wet rolling or stamping process, and the product elevated to the palong by gravel-pump?

PROGRESS REPORT BY H. SERVICE, GEOLOGIST.

55. The writer was stationed at Head Office in Batu Gajah in January and February, for five weeks during May and June, and from October to December: he spent the remainder of the year at Kuala Lipis, with the exception of the month of September, when he was on short leave in New Zealand.

The writer himself carried out little field work but his assistants, Inche Abdullah bin Ismail, Inche Kassim bin Majid and Inche Abdul Rani bin Mohd. Salleh continued their jungle trips in the Lipis area until outside work was stopped in June on account of the emergency in Malaya.

56. Field work during the year brought nearer to completion the geological mapping of the area topographically surveyed on sheets 2 N/16, 2 O/13 and 3 C/1 but a final report cannot be prepared until local conditions improve sufficiently to allow a few relatively small parts to be examined in further detail. The general geological description of the area as published in paragraphs 126-130 of the Report of the Geological Survey Department for the year 1946 remains unaltered.

MINERAL POTENTIALITIES OF THE LIPIS AREA, PAHANG.

57. The prospects for large scale mining development in the Lipis and Benta areas are not promising. Conclusions reached during the recent detailed geological survey confirm the opinion of Mr. J. B. Scrivenor who remarked in his publication *The Geology and Mining Industries of Ulu Pahang* (1911 p. vii): "The fact remains, however, that the gold industry is now practically centered in two of the Raub mines and that the greater part of Ulu Pahang produces no tin-ore at all, and never will, I fear, produce it in large quantities."

58. Minerals of economic importance certainly do occur in the area: alluvial gold, for example, is found in most of the major drainage basins, and alluvial tin-ore has been reported from the Ulu Cheka area; lode gold-ore *in situ*, as distinct from transported alluvial gold, has been worked in the past in at least two parts of the district; and a few tons of lode galena (lead sulphide) were mined some years ago near Kg. Batu Balai. The deposits of these minerals, however, do not appear to be large.

59. Gold is the only mineral of economic importance which has had a successful mining history in the area. The Kechau and Penjom (Punjom) lode gold mines have long been closed down and their underground workings are largely or wholly inaccessible. Little accurate information has been found from old records nor can it be obtained from mere surface inspection of these lode areas. It might, however, be worth while in the future for them to be given a thorough surface and underground examination. (Brief descriptions of these mines are given in the Annual Report of the Geological Survey Department for the year 1939, paragraphs 54 and 55).

60. Alluvial gold has been worked successfully under mining lease at Penjom (Punjom), Sungei Mutan, Ketir, and at several places near Tanjong Besar. In addition, recent gold stealing has been in operation in other such widely distributed areas as the Tersang, Telang, Koyan, Bertam, Tepuai, Talon, Kerak, Lau, Sibar, Krambit, Atong and Sepan drainage basins. In the Penjom, Sungei Mutan and Ketir occurrences, the gold is in part residual from weathering of auriferous quartz veins in muscovite aplite and in part alluvial (Annual Report of the Geological Survey Department for the year 1946, paragraph 131). In the remainder of the above-mentioned localities, however, the gold appears to be purely alluvial and its place of origin is not known: presumably the majority of the gold is derived from auriferous quartz veins too small to be readily found in the field.

61. A factor which militates strongly against the chances of finding large and deep alluvial deposits of gold or, for that matter, of any other alluvial mineral, is the general thinness of the alluvial beds in the area. Several of the river valleys are wide and would appear at first sight to be infilled with deep alluvium. The cross sections of these valleys, however, show steep walls and flat floors covered by only a veneer of alluvium: the floor, for example, of the Teris valley near Kg. Teris is half a mile wide but the alluvium it carries is so thin that limestone bedrock outcrops in numerous places across its whole width. Alluvial ground suitable for deep dredging, therefore, is not likely to be found in the area, but additional, payable, shallow deposits suitable for gravel pump mining may yet be located.

NOTE ON FOSSILS FROM THE LIPIS AREA, PAIHANG.

62. Before detailed geological mapping was commenced in 1939, published reference had been made to fossils collected from four localities in the Lipis area (Scrivenor, "The Geology of Malaya", 1931, pages 56, 64-66), and it had been established that Permian and Carboniferous shales and limestones occurred both to the east and west of Kuala Lipis while Upper Triassic shales and quartzites extended in a narrow belt passing approximately through Kuala Lipis. Detailed structural mapping has since shown that the Triassic beds are folded synclinally into the older rocks, but it has not been found possible to mark accurately on lithological grounds the boundaries between the two series. Ten collections of fossils made by the writer and his assistants have provided information confirming the general structure of the whole area, and a recent collection made by Mr. H. E. F. Savage will, it is hoped, prove most valuable in elucidating the stratigraphy of the eastern limb of the Lipis syncline.

63. Extracts are appended from reports by members of the staff of the British Museum upon the collections of fossils which they have been good enough to examine.

No. 15665: Shale from Sungei Jemeru, 8½ miles south-southeast of Kuala Lipis. The fossils consist of indeterminate stem fragments and detached columnals of crinoids, fragmentary polyzoa, lamellibranchs and brachiopods. The brachiopods include *Dictyoclostus* sp., *Marginifera* sp., *Uncinunellina timorensis* (Beyrich), *Spiriferellina* sp., *Spirifer* sp. and *Leptodus Lyttonia* sp. The age of rock is Permian, probably Upper Permian. (Dr. H. M. Muir-Wood).

No. 14838: Mudstone in Sungei Kelidik, 10 miles north-northwest of Kuala Lipis. The fossils are indeterminate moulds of crinoid stems and a few vague lamellibranch impressions. A Permian age is most probable as the crinoids resemble certain specimens from the *Productus* Limestone of the Salt Range, figured by Waagen as *Poteriocrinus*? sp. (Dr. L. R. Cox).

No. 15620: Green tuff from Sungei Lana, 3 miles east-southeast of Kuala Lipis. The rock contains hollow moulds, stem fragments and detached columnals of crinoids of probable Palaeozoic age. (Dr. L. Bairstow).

No. 15621: Grey-black shale from Sungei Perenggan near Kuala Lipis. A Lower Triassic age is suggested for this rock on account of the presence of several crushed specimens which bear a considerable resemblance to *Pseudomonotis* (Claraia) *Aurita* Hauer. (Dr. L. R. Cox).

No. 14820a: Argillaceous quartzite at the 3rd mile post on the road from Kuala Lipis to Benta. The sample yielded the following species of lamellibranchs: *Myophoria* sp. nov. present in great numbers, *Myophoria myophoria* (Boettger) and *Anodontophora trapezoidalis* Mansuy. The horizon of the rock is Upper Trias. (Dr. L. R. Cox).

No. 14820b: Argillaceous quartzite at the 3½ mile post on the road from Kuala Lipis to Benta. The following species of lamellibranchs were found: *Palaeoneilo* cf. *elliptica* (Goldfuss), *Palaeoneilo* sp. nov., *Myophoria* cf. *myophoria* (Boettger), *Casianella* sp. nov. and *Astarte* cf. *willebadessensis* Roemer. The horizon is Upper Trias. (Dr. L. R. Cox).

No. 14834: Argillaceous sandstone from Sungei Som, 2 miles north of the Benta-Jerantut road. The sample was found to contain the following species of lamellibranchs: *Posidonia* cf. *wengensis* Wissman and *Daonella* or *Halobia* sp. The horizon is most probably Triassic. (Dr. L. R. Cox).

No. 15619: Argillaceous quartzite from the 1st mile post on the road from Kuala Lipis to Benta. Great numbers of *Myophoria* sp. nov. occurred in this sample identical with the species in No. 14820a, together with *Gervillia* (*Langsonella*) *elongata* Mansuy and *Anodontophora trapezoidalis* Mansuy. The horizon is Upper Trias. (Dr. L. R. Cox).

No. 14836: Sandy mudstone at the 33½ mile post on the road from Benta to Jerantut. The sample contained the following lamellibranchs: *Myophoria malayensis* Newton and *Myophoria* cf. *harpa* (Munster). The horizon is Upper Trias. (Dr. L. R. Cox).

No. 14839: Mudstone in Sungei Kijai, north of the 34th mile post on the road from Benta to Jerantut. The sample consisted partly of a soft pink mudstone and partly of a yellow sandy shale. The pink mudstone yielded the following lamellibranchs: *Myophoria malayensis* Newton, *Hoernesia* sp. indet., *Gervillia* (*Langsonella*) *elongata* Mansuy, *Mytilus* cf. *rugulosus* Bittner, *Anodontophora* cf. *elisabethae* Patte, *Myoconcha*? sp. indet. *Myophoria malayensis* Newton was found in the yellow sandy shale. The horizon of the samples is Upper Trias. (Dr. L. R. Cox).

PROGRESS REPORT ON GEOLOGICAL WORK IN SOUTH-WEST PAHANG AND IN PART OF NORTH-WEST SELANGOR BY J. B. ALEXANDER, GEOLOGIST.

64. Field mapping on the Pahang portion of the area covered by Topographical Sheets 3 B/8 and 3 B/12 was completed by the writer before he proceeded on study leave in 1947. Further work, on that portion of the Selangor area north of the Bentong to Kuala Lumpur Road, was carried out by Mr. F. W. Roe during the early part of 1948, but the onset of the present emergency has prevented the completion of that portion to the south thereof: this will be examined as soon as conditions are favourable.

The writer returned to Malaya on the 3rd November, 1948, and re-assumed duty at Bentong on the 6th November. Three weeks were spent attending the annual conference at the head office, Batu Gajah, during which period also certain memoranda were prepared. The remainder of the time has been occupied by preparing part of the final draft of the geological memoir on the Bentong area, together with plans and illustrations connected therewith.

65. Many of the results of the work in the area have already been published previously (Annual Reports of the Geological Survey Department for the year 1939, paragraphs 63-71; 1940, paragraph 38; 1946, paragraphs 133-154; 1947, paragraphs 50-80). The gist of the recommendations for future prospecting in the Pahang portion of the Bentong area, however, has not so far been made public, but is now included in this interim report before the memoir is completed.

RECOMMENDATIONS FOR FUTURE PROSPECTING IN THE BENTONG AREA.

GENERAL CONSIDERATIONS.

66. The only metalliferous ores likely to offer any chance of economic working in the Bentong area at present appear to be those of tin, and in times of favourable market conditions, of tungsten. Relatively insignificant amounts of gold may be found in some places and recovered as a by-product in the recovery of tin-ore. At the same time it must be borne in mind that future developments in research may bring into greater prominence a number of rarer minerals, such as are liable to occur in the granite areas and in the alluvium derived therefrom.

Consequent on the recent detailed examination of the Bentong area it has been possible to revise the regional map of this part of Pahang showing mining land, probable and possible new mining tracts, and other areas where economic deposits are considered unlikely to occur.

ALLUVIAL TIN-ORE.

67. There is no doubt that, over much of the area between the Sungei Tras and the Sungei Dua Olak, the eastern side of the Main Range is stanniferous. Cassiterite is widely distributed and is present in most of the streams draining from granite country. Broad alluvial plains comparable with those of Kinta, Batang Padang, and Kuala Lumpur tin-fields to the west of the Main Range are absent however: furthermore the physical conditions are not so favourable for the accumulations of large thickness of alluvium. The topography is controlled by a series of north-northwesterly ridges separated by steep-sided valleys so that reasonably big alluvial plains suitable for large-scale mining are thus restricted in number, although smaller deposits derived from the denudation of the granite mass have in the past provided payable properties in the Tras, Kenong, and Bentong valleys as well as those further to the south in the Pertang and Baris valleys of the Manhis area (Topographical Sheets 8 C/9 and 3 C/13).

68. The alluvium, where it overlies quartzite, phyllite, or schist bedrock, is generally shallow and rarely exceeds 25 feet in thickness. It is usually less than 20 feet deep, averaging between 15 and 16 feet over two areas prospected in the Kenong valley, 17 feet in the dredged area of the Bentong valley, and 17 feet in the gravel-pump area of the Baris valley. In the Pertang valley, however, where there is limestone as bedrock, the depth averages 60 to 70 feet, and even as much as 100 feet was recorded by one scout-bore. Here traces of old shaft workings at different levels could be seen in the year 1941.

69. The Kenong alluvial and other small valley areas have not yet been subjected to systematic working, but should contain areas of payable ground exploitable by gravel-pump or drag-line excavation mining methods. Abundant water power is generally available for utilization in such localities.

70. With present day and future improvements in the technique of recovery and concentration of finely divided cassiterite, there is little doubt that the Repas-Lebah-Perting silt retention areas should be tested with a view to profitable exploitation by dredging. In these areas it is estimated that, at the present time, there are more than 20,000,000 cubic yards of granite wash available, overlying a schist bedrock to depths as great as 30 feet or more.

71. In the Bentong valley, parts of which, between mile-posts 64 and 70, were dredged during the period from 1917 to 1939, it is possible that certain sections would be found suitable for clean-up by gravel-pump. The town of Bentong itself stands on alluvial ground which was only fossicked by early workers and was not dredged. Prospecting lower down the Bentong river, near Karak, disclosed some 500 acres of land where boulders are few and the arenaceous ground is suitable for bucket-dredging. There is a chance that other areas suitable for gravel-pump mining may be discovered by careful prospecting.

ELUVIAL TIN-ORE.

72. A sharp line cannot be drawn either between the strictly eluvial deposits and decomposed rock "in situ", or between the decomposed rock and the undecomposed lode-rocks from which they were formed, for the latter grade imperceptibly from fresh unweathered rock in depth, through partially decomposed intermediate material, to fully decomposed ground near the surface, some of which has moved away slightly from its original position, shown by hill-creep under the influence of gravity. For the purpose of this report, however, in contradistinction to lode tin-ore, it is to be understood that by eluvial tin-ore is meant that stanniferous material which can be easily removed without blasting, and which does not necessitate crushing before the tin values can be extracted.

73. In the Bentong area there are some very large tracts of land containing workable quantities of such eluvial tin-ore. It is from this type of working that more tin-ore has been won in the past than from alluvial mining. The prospecting of decomposed stanniferous granite and schists is therefore of great importance, and when it is remembered that the working of such deposits frequently results in exposing veins of cassiterite-bearing rocks, it will be realised that the removal of this softened ground is the best method of initial prospecting for lodes. Re-examination of all the old mining land hitherto usually worked by inefficient methods, with a view to opening up likely areas, will probably be profitable.

74. Most of the Main Range granite between Tras and Fraser's Hill, Murai, and the Sungei Dua Olak, is known to be extensively mineralised, and there is a probability of a future mining revival; also, possibly, in the Patah Keris portion of the Tangli catchment area. On the other hand no obvious indications of usually associated tourmaline or topaz have been observed in the area to the south-west of the Ulu Tangli to Ulu Benus-Kenaboi lincation, although small amounts of these minerals have been noted in some stream gravels. Furthermore the granite in this area is of a rather different texture. It is therefore not considered likely that any profitable deposits of tin-ore will be found in this section of the Main Range.

75. Ground sluicing and hydraulic mining are the most satisfactory means by which the decomposed ground can be removed. These methods give rise to a difficult problem on account of the enormous quantities of tailings, which are deposited in the valleys and are liable to silt up roads, agricultural land, and villages, unless properly retained. In most cases it is impossible, owing to heavy rainfall and the steepness of the ground, to effect satisfactory nearby disposal of these tailings permanently. Part of the Bentong area, however, is extremely fortunate, in that adequate large-scale retention schemes can be easily effected in the longitudinal valleys between the granite and the schist hills. Three tailings retention dams were completed across the Repas, Lebah, and Perting valleys, between the years 1925 and 1929, and have subsequently been successively raised under the supervision of the Drainage and Irrigation Department: until an additional capacity of little more than 7,000,000 cubic yards now remains under the original provision.

76. A new comprehensive scheme is at present under consideration for increasing the tailings retention capacity of the Repas-Lebah-Perting area by an additional 100,000,000 cubic yards, but this amount would still be inadequate for any really large-scale operations. Following the construction of three new dams to suitable heights commensurate with the scale of the operations envisaged, it should be possible to retain several hundred million cubic yards over an area of 3 to 4 square miles. This would enable the working of many hundreds and thousands of acres of ground known to be suitable for sluicing, in a catchment area comprising approximately 52 square miles of granite and nine square miles of schist. During the course of such large-scale operations much low-grade tin-bearing ground not workable economically by other means would be exploited, and exposures of lode prospects would possibly be revealed.

LODE TIN-ORE.

77. In addition to the alluvial and eluvial tin-ore deposits in the hills, low-grade disseminations, sometimes with localised enrichments of cassiterite, sometimes separated by much barren ground, are known to occur over a widespread area in the granite and in the schists near the granite contact. The following considerations will be confined to the general prospects of finding economically exploitable tin-ore deposits in the granite. The most important factor is not in what types of rocks mineralization may occur but in the location of the places where lines of weakness have rendered the rocks suitable for the penetration of the late-stage differentiates and effluents released from the granite magma during consolidation. For a thorough study of these lines of weakness the number and extent of natural and artificial exposures available are woefully inadequate. In fact, until large-scale prospecting is undertaken on the lines already indicated, it will not be possible to form a reliable opinion on the mineralization values and their economic worth. Local enrichment of tin values has been noted in the past, and there must be many other undisclosed lodes hidden beneath the thick blanket of weathered rocks and vegetation.

78. A study of the rocks exposed by ground sluicing or hydraulic mining operations will ultimately show the main trend-lines of the fissures and fractures along which the concentrations of cassiterite occur. Special attention should always be made to the

vicinity of the intersection of two or more of these zones of mineralization, as it is at these points that pipe-like enrichments are likely to be found. At Chagar, it has been shown that the tin-ore deposits are closely associated with the finer-grained varieties of granite and, in fact, are richest at the contact of these intrusions into the coarser-grained varieties, in particular where they form small elongated apices or apical bosses. In other localities these apices may be only a short distance below the ground surface and, although of small extent, might be exposed if the superficial residuum could be removed. In other cases they would lie at greater depths, but their presence might still be revealed by fracture lines in the overlying coarser granite.

NATURE OF MINERALIZATION IN RELATION TO MINING.

79. The very general nature of the mineralization in the region appears to be the main drawback to successful mining since, as already explained, the commonest type of primary ore deposit consists of barren granite traversed by a series of thin parallel steeply-inclined veins, containing tin-ore. In a total width of 15 feet, there may be less than two feet of rock carrying tin-ore, 13 feet being barren. The significance of this in mining is that, either a large amount of barren rock must go through the mill, or the stone must be handpicked before milling. The latter measure has been adopted by the small Chinese kongsis working in the mountains: it is not difficult to apply because the ore is generally black and the barren rock grey, thus allowing separation by unskilled labour.

Several of these enrichments have been worked in the past, but the lack of persistent concentration in most areas, in spite of the widespread nature of the mineralization or perhaps as a result of it, has hitherto formed the main obstacle to successful exploitation. Insufficient rich ore could be developed to keep a mill working for very long. As a result, it would appear that the search for and the working of high-grade ore-bodies alone is not likely to be an economic proposition, and that the low-grade type of ore deposits, with which the richer deposits are usually associated, must also be mined. In this connection it is well to emphasize that mining methods are continually being improved and that ore deposits of lower grade than hitherto can be successfully treated under reasonable marketable conditions. It is possible that large-scale, soft-milling, low-grade properties could be profitably worked in the future by utilizing the cheap water power available. The establishment of a flourishing lode mining industry will depend on whether large-scale operations on the poorer-grade deposits can be made a commercial success.

SUMMARY.

80. Some alluvial ground still remains to be thoroughly prospected and worked, but there is no likelihood of any large stanniferous areas suitable for big dredges being formed, although a small dredge might be able to operate profitably in the lower part of the Bentong valley near Karak.

81. The chief hope of a revival of the tin mining industry in the Bentong area lies in large-scale workings on the Main Range. Systematic ground sluicing and hydraulicing in the valleys, and on the hill-slopes, could provide a considerable amount of tin-ore, especially in the catchment area of the Repas, Lebah, and Perting rivers. The construction of three new larger dams to a sufficient height across these valleys would enable the retention of tailings from a catchment of 52 square miles of granite country, the whole or part of which area could then be stripped of its cover of jungle and decomposition products, including many low-grade eluvial tin-ore deposits.

82. At the same time the cost of such a large-scale prospecting operation would be partly met by the proceeds from the tin-ore recovered, quite apart from the possible remuneration resulting from the uncovering of as yet undisclosed mineral lodes and disseminations. Furthermore the retention areas created could subsequently be cleaned up by a large modern dredge capable of recovering the fine tin-ore escaping from the operations in the hills.

83. If this proposal were to be carried out, as assuredly it will have to be when the present alluvial tin-bearing formations in other parts of Malaya become exhausted, then a detailed examination of the rocks so exposed will enable a more accurate assessment to be made of the character of the primary tin mineralization in the Main Range granite. As yet there is insufficient evidence on which to base a really reliable idea of its value.

The degree of success or otherwise of such operations in the Bentong area will also enable the evaluation of similar tin-ore deposits in the adjoining Tras (Raub), Peretak (Ulu Selangor), and other mineralised granite areas, where the ecological implications call for tailings retention schemes of a more expensive character. Similar operations in such areas may or may not be rendered uneconomic on this account, but it is certain that their chances of success would depend more critically on the grade of ore encountered.

PROGRESS REPORT ON GEOLOGICAL WORK IN SELANGOR BY F. W. ROE, GEOLOGIST.

84. Most of the year has been spent in Selangor completing work in North Selangor and some small adjoining parts of Perak and Pahang. The area surveyed and resurveyed is covered by Topographical Sheets 3 B/7, 3 B/10, 3 B/11 and the part of Selangor shown on Sheet 3 B/8. The first seven months of the year were mostly occupied with field work and the remaining five months have been taken up with the preparation of maps and memoirs.

Bandit activities have caused slight inconvenience, preventing the carrying out of about two weeks' field work, required to complete the detailed mapping. The good work carried out by a field assistant and four rock collectors made it possible to complete the resurvey of almost nine hundred square miles in the short time available. A memoir on the Fraser's Hill area, covered by Sheet 3 B/7 and part of Sheet 3 B/8, has been written and the main features are summarised in paragraphs 85-97. A memoir on the Kuala Selangor and Rasa neighbourhood, covered by Sheets 3 B/10 and 3 B/11, is being prepared and the main features are described in paragraphs 98-120. The mineral production figures quoted in this report have been supplied by the Mines Department.

Considerable economic geology has been performed outside the area under detailed survey; the main features are summarised in paragraphs 121-129. About two hundred enquiries were dealt with at the Kuala Lumpur Office for Government Departments and the general public. The importance cannot be over-stressed of having a fully equipped and staffed office in Kuala Lumpur where many mining companies and most Government Departments have their head offices.

THE GEOLOGICAL SURVEY OF THE AREA COVERED BY TOPOGRAPHICAL SHEET 3 B/7 AND THAT PART OF ULU SELANGOR COVERED BY SHEET 3 B/8.

85. The resurvey of approximately three hundred and five square miles of country covered by Topographical Sheet 3 B/7 and the part of Ulu Selangor shown on Sheet 3 B/8 was completed in April, 1948. A memoir on the area has been written and is

almost ready for publication. The main features of the geology and mineral resources are summarised below in paragraphs 86-97. Geological details have previously been given in the following Annual Reports of the Geological Survey Department: for the year 1937 in paragraphs 164 to 190; in the 1938 Report in paragraphs 112 to 133; in the Report for 1939 in paragraphs 43 to 83; in the 1940 Report in paragraph 35. Work carried out in 1941 is described in paragraphs 77 to 83 of the Annual Report for 1946 and work performed in 1947 is summarised in paragraphs 82 to 84 of the Report for that year.

THE METAMORPHOSED SEDIMENTARY ROCKS.

86. The oldest rocks in the area, referred to as the calcareous series, are believed to be Carboniferous or Permocarboniferous in age. They occupy about sixty-eight square miles and consist of limestone, phyllite and shale; rare bands of mica-quartz schist, fine grained quartzite and chert occur. Graphitic material and pyrite is common and most of the limestone is dolomitic. These rocks are folded and dips vary between 45° and vertical; recumbent folds occur near the granite.

87. The arenaceous series was formed at a later period, probably in Triassic times; there is possibly an unconformity between these rocks and the calcareous series. The arenaceous series occupies about one hundred and five square miles and comprises quartzite, schist, schistose-grit, hornstone and shale; subsidiary amounts of mica-schist, phyllite and shale occur. The rocks of this series are folded and have an average inclination of 45°. Sporadic volcanic activity occurred during this period giving andesite and andesite-porphyry of the Pahang Volcanic Series.

The stratified rocks of these two series build the undulating country in the south-western sector of the Fraser's Hill area. No fossils have been found in the rocks in the area under survey. The estimate of their age is based on their lithological similarity to fossiliferous Carboniferous to Triassic strata elsewhere in Malaya. Small outcrops of dolerite and rocks of the Pahang Volcanic Series are exposed with the arenaceous series. Amphibole schist occurs sparingly in both groups of rocks. Sedimentation appears to have ceased and terrestrial conditions to have prevailed at the end of the Triassic period. These conditions probably persisted until the intrusion of the Main Range granite.

GRANITE AND ALLIED ROCKS.

88. Granite builds about one hundred and twenty-six square miles of highlands in the north-east of the area under survey. The magma from which it has formed was emplaced in Jurassic, Cretaceous or early Tertiary times. Its cooling was accompanied by fluidal movement and differentiation which resulted first in the formation of coarse porphyritic biotite granite and later of granite porphyry and micro-granite. Medium to fine grained granite carrying epidote and chlorite also occurs. Its intrusive relationship to the other granite types is not clear. It may have developed its characteristics as the result of assimilation of sedimentary rock or they may have resulted from alteration accompanying the cooling and regional metamorphism of the batholith. Intrusions of aplite and pegmatite followed. Cassiterite pneumatolysis and then hydrothermal activity occurred, resulting in the formation of schorl, greisen and quartz

veins carrying tin-ore (cassiterite) and later of numerous quartz veins which penetrated both the consolidated granite and the enclosing sedimentary rocks of the calcareous and arenaceous series.

The tin-ore was introduced by a residuum left as a result of the cooling of the granite magma. It occurs in the Main Range and in some of the sedimentary rocks in contact with these granite mountains. In the granite, cassiterite is commonly associated with tourmaline and mica, also to a lesser extent, with fluor and topaz. It is chiefly located in zones consisting of a parallel vertical series of narrow quartz-tourmaline and greisen stringers, separated from one another by granite barren of mineral wealth. Stockworks of these veins also occur. In the sedimentary rocks the bulk of the tin-ore is carried by small quartz veins with which occur a little mica, tourmaline and sulphides, mainly pyrite and arsenopyrite.

Gold has been recorded in quartz veins formed after deposition of the tin-ore. Such veins are probably the source of the small amounts of gold occasionally produced as a by-product of tin mining.

STRUCTURE.

89. Widespread earth movements accompanied the emplacement of the granite. These possibly preceded the intrusion of the magma; they accompanied its cooling and continued after it had consolidated. The movements resulted from powerful compressional forces operative from the west-southwest which appear to have encountered resistance east of the area under survey. The regional structure of the area, which is north-northwest to south-southeast, as well as the majority of the rock structure has been determined by these movements.

Dominating the region is the tectonic axis of the Main Range granite. In the granite the pressures produced narrow zones of fracturing, shearing and foliated rock, comprising sheared granite, schistose granite, mylonite and mylonite gneiss. The sedimentary rocks are also regionally metamorphosed and foliation and schistose structures show the common regional trend. The regional direction is also followed by the contact between the Main Range granite and the sedimentary rocks, by three large roof pendants on the granite and by many of the fine grained granite intrusions. The few isoclinal and recumbent folds in rocks of the calcareous series follow this regional trend, as do inter-stratified bands of limestone.

90. The structure of the area has affected the economic development since it determines the position of the resistant rocks of the arenaceous series and granite, in relation to the easily eroded rocks of the calcareous series. Thus low-lying country, built from rocks of the calcareous series, lies between the resistant Main Range granite mountains and hill country, formed from rocks of the arenaceous series. This valley area follows the regional north-west to south-east direction and has formed a natural catchment for the accumulation of tin-bearing alluvium; also the easiest route for the main communications, the railway and the trunk road north.

RECENT DEPOSITS.

91. The only deposits found in the area under survey that are younger than the granite are the recently formed superficial deposits.

After the formation of the Triassic sediments and the Main Range granite there follows a long period unmarked in this part of Selangor by any record in the geological time scale. This suggests that the area formed a land mass and terrestrial erosion was taking place. Although no Tertiary rocks have been found in the Fraser's Hill area sediments were laid down under swamp conditions in Upper Tertiary times just outside the mapped area.

92. The superficial deposits comprise alluvium brought down from the Main Range mainly by the Selangor, Kerling, Inki and Bernam rivers, and eluvial material formed as a result of tropical weathering. Economically these recent deposits are the most important formation in the area. Much of the alluvium contains tin-ore, and the eluvium is also tin-bearing at some localities where it overlies granite and sedimentary rocks near the granite contact.

ECONOMIC GEOLOGY OF THE AREA COVERED BY
SHEET 3 B/7 AND THAT PART OF ULU SELANGOR
COVERED BY SHEET 3 B/8.

93. Tin-ore is the only mineral of economic importance in the areas under consideration. The development of this district has been based largely on revenues derived from the tin industry. Sir Frank Swettenham wrote in "British Malaya" in 1906: "Tin has enabled the administration to rapidly open up and develop the country which thirty years ago was practically covered by virgin forest. It was the clear policy of the Government to encourage the mining industry by every legitimate means". The area under survey was one of the localities included in this statement and to-day it is still an important producer of alluvial tin-ore and contains a considerable proportion of the known Malayan lode tin deposits. In 1948, however, only 0.4 per cent. of the land was alienated for mining and no ore was produced from the lodes, all the tin output, totalling 10,750 piculs, coming from alluvial deposits. Gold is produced occasionally in small quantities as a by-product of tin mining in the Selangor and Inki valleys. Other minerals, which would be of economic interest if they occurred in sufficient quantity, include torbernite (a uranium mineral), monazite, zircon, ilmenite, sphalerite, chalcopyrite and graphite. Of these only a small amount of ilmenite, obtained as a by-product of tin dredging, has been sold. There are no indications that payable deposits in situ of the radio-active minerals containing uranium and thorium occur. Lateritic iron-ore and limonite are present and are used locally for the construction of secondary roads and rubber estate roads. An unlimited supply of good quality granite, suitable for use as both road metal and building stone, is available. The waters of the hot springs in the area are said to be of medical value for treating skin and rheumatic complaints.

94. Tin-ore has probably been mined for centuries in this area. Production at present comes from alluvial mines, but lode deposits yielded approximately 10,000 piculs annually for many of the years between the beginning of the century and 1933. Mining of lode tin declined after 1933 and finally stopped eight years later, not because the tinfield had become exhausted but owing to the prohibition of the hydraulic working method, known as lampan mining, by which the majority of the ore bodies could be exploited and lodes found. Prospecting of the lodes containing tin-ore in the late 1930's indicated that the ore bodies in the granite, at the few localities tested, did not contain tin in payable quantities below about three hundred and fifty feet from the surface. This appeared true even when the structures, which had played an important part in localising the tin deposits, persisted in depth.

THE FUTURE PROSPECTS OF TIN MINING.

95. The annual production of alluvial tin-ore for the next ten to fifteen years from this area will probably return to approximately the 1940 figure of about 20,000 piculs. Fluctuations in the amount of ore produced are more likely to result from unpredictable political and economic factors than from large finds of new tin deposits or the sudden exhaustion of deposits worked at present. The 1948 production of tin-ore, totalling 10,955 piculs, as a result of the Japanese occupation and bandit activities, is smaller than might normally be expected. Dulang washers produced an additional 1,928 piculs of tin-ore in the district of Ulu Selangor; much of this ore came from the area under survey.

96. A big increase in alluvial tin production in this area is improbable as the richer beds have mostly been mined and there is little prospect of discovering additional large tracts of tin-bearing alluvium. Limited extensions to existing tin producing areas will probably be found in the valley areas drained by the Selangor, Inki and Kerling rivers. In the future, as at present, alluvial tin production is likely to depend mainly on dredging. Ground now mined averages about 0.5 katies of tin-ore per cubic yard. In another ten to fifteen years most of these tin deposits in this area will have been mined and the alluvial areas may be abandoned if new methods, or higher prices, do not make it profitable to work deposits of a lower grade than can be treated at present.

97. The mining of the lode deposits in the Main Range should be resumed when alluvial tin-ore can no longer be profitably worked, for the waste products can then be stored in the natural catchments which the worked-out alluvial areas would form. Workable lodes appear most likely to be found in the Peretak Hills.

THE GEOLOGICAL SURVEY OF THE PART OF NORTH SELANGOR COVERED BY TOPOGRAPHICAL SHEETS 3 B/10 AND 3 B/11.

98. The resurvey of the portion of North Selangor covered by topographical sheets 3 B/10 and 3 B/11, totalling approximately five hundred and eighty-five square miles, was commenced in April, 1948, and almost completed at the end of July.

At three localities bandit activities have prevented the completion of some field work. The memoir covering this area is now being written and should be ready for publication in 1949. Accounts of the geology and mineral resources of this part of Selangor were given in the Annual Reports of the Geological Survey Department listed below. For the year 1939 in paragraph 84; in the 1940 Report in paragraph 35; in the 1946 Report in paragraphs 84 to 105, and in the 1947 Report in paragraph 85.

THE METAMORPHOSED SEDIMENTARY ROCKS.

99. The oldest rocks in the area, referred to as the calcareous series, are believed to be of Carboniferous or Permocarboniferous age. No fossils have been found in these rocks in North Selangor and the estimate of their age is based on their lithological similarity to rocks of this age elsewhere in Malaya. They have been recorded over approximately one hundred and thirty-five square miles, much of which is lowland country where the rocks are obscured by alluvial deposits. The

series consists of limestone, phyllite, schist and shale; rare bands of mica-quartz schist, fine grained quartzite and chert occur. Graphitic material and pyrite are common in these rocks. Most of the limestone is dolomitic but some of the rock in the Rawang and Kanching areas is low in magnesia. The rocks of this series are folded and foliated and the dips are mostly between 45° and vertical.

100. The arenaceous series of rocks is thought to be of Triassic age on account of its lithological similarity to rocks elsewhere in Malaya known to be of this age. There is possibly an unconformity between this group of rocks and those of the calcareous series. The arenaceous series occupies almost one hundred and fifty square miles and mainly forms undulating hill country. This series of rocks comprises quartzite, quartz schist, schistose grit, quartzose grit, hornstone and quartzite conglomerate. Many of these arenaceous rocks are shaly and beds of mica schist, phyllite and indurated shale occur. Graphitic material is also present but is not abundant. These rocks have been folded and the average inclination varies between 20° and 45°.

GRANITE AND ALLIED ROCKS.

101. Granite occupies about one hundred and thirty square miles of this part of Northern Selangor. In the east of the area under survey it builds the Main Range mountains. To the extreme west it forms two isolated hills at Kuala Selangor while in the Batang Berjuntai district it has been found below alluvium. The magma from which the granite has formed was emplaced in Jurassic, Cretaceous or early Tertiary times. Its cooling was accompanied by fluidal movement and differentiation which resulted in the formation of coarse porphyritic biotite granite, muscovite-biotite granite which is generally sparsely porphyritic, and later of granite porphyry and microgranite in which tourmaline is common. Intrusions of aplite and pegmatite followed. Cassiterite pneumatolysis then hydrothermal activity occurred, resulting in the formation of tin-ore (cassiterite) and later of numerous quartz veins which penetrated both the consolidated granite and enclosing sedimentary rocks of the calcareous and arenaceous series. Quartz intrusions carry wolfram as well as cassiterite in the Sungei Liam valley, at Kanching and three miles north-east of Serendah. At these localities the intrusions all occur at, or near, the contact of sedimentary rock with granite.

Where these mineral-bearing veins cut the sedimentary rock the proportion of wolfram is high; at places where they persist into the granite the intrusions are richer in cassiterite and poorer in wolfram. Scheelite occurs in the Batu and Kanching areas where granite is in contact with limestone.

102. The tin-ore was introduced by a residuum left as a result of the cooling of the granite magma. It occurs in the Main Range granite and in the sedimentary rocks which border the mountains in the Batu, Kanching, Rawang, Serendah and Ulu Yam Bharu areas, but to date only low grade deposits have been found.

A few small tin-bearing intrusions have also been recorded in the past in the valleys of the Gong, Kundang, Kuang, Garing and Sembah. In the granite the tin-ore is commonly associated with tourmaline and mica, and occurs mostly in narrow tourmaline, quartz-tourmaline and greisen stringers. In the sedimentary rocks the tin-ore is mainly carried by small intrusions of vein quartz, aplite, pegmatite and granite.

THE TERTIARY BEDS.

103. Tertiary deposits cover just under five square miles of country at Batu Arang in the south-east portion of Sheet 3 B/10. The beds consist of shale, sandstone, coal and conglomerate and are mostly overlain, possibly unconformably, by boulder beds. A small patch of shale, that may be of Tertiary age, occurs below the swamps north of Batang Berjuntai. The deposits at Batu Arang rest unconformably on quartzite and phyllite, believed to be of Triassic age. They were probably laid down in an isolated, trough-shaped depression occupied by fresh water swamps in Upper Miocene times. Originally deposited as beds of sand, clay and vegetable matter, they have subsequently been converted into sandstone, shale and coal. Most of the strata are gently inclined, the average dip in the north and east of the field being 14°, but inclinations up to 45° have been recorded at the edges of the beds. Small, normal-type faults are common causing displacements of a few feet; the largest fault recorded by the management was said to have had a throw of about eighty feet.

In 1941 prospecting of the coal was commenced and four deep diamond drill holes, totalling four thousand six hundred and twenty feet, were sunk. The bores penetrated the Tertiary beds and entered the underlying Triassic quartzite and phyllite. The first diamond drill hole (No. 1), put down where there were geological indications that the Tertiary deposits might attain their greatest thickness, showed the following succession below datum of sea level:—

	Thickness in feet.
BOULDER BEDS, possibly of Upper Tertiary age ...	1,164
COAL MEASURES, probably of Upper Tertiary age, comprising sandstone, shale, coal and coaly-shale ...	298
QUARTZITE, believed to be of Triassic age; thickness penetrated ...	189
Total depth of hole below sea level ...	1,651

104. These deposits are economically of great importance to Malaya, forming the only coalfield worked at present in the country; the output is described in paragraph 110.

STRUCTURE.

105. The Main Range mountains of granite, following a tectonic axis trending from north-northwest to south-southeast, dominate the region. Most of the foliation and folded structures in rocks of the calcareous and arenaceous series are parallel to this trend. The zones of sheared and mylonitised granite and two bands of sedimentary rock extending over the granite highlands (one from Ulu Yam to Ginting Sempak on Topographical Sheet 3 B, 12 outside the area under survey, and the other from Batu to Kanching) have the same general strike.

Widespread earth movements accompanied the intrusion and cooling of the granite and continued after it had consolidated. They had ended when the Upper Tertiary beds at Batu Arang were formed. Powerful compressional forces from the west-southwest appear to have encountered resistance east of the area under survey and resulted in the buckling and folding of the sedimentary rocks of Carboniferous and Triassic age and shearing and fracturing of the granite. A long period of terrestrial erosion appears to have followed and even to have continued over much of the region through Upper Tertiary times. There are indications that terrestrial conditions persisted even when the Batu Arang coal measures were laid down, for they appear to have formed in an isolated trough occupied by fresh water swamps. After their deposition earth movements occurred with downward tilting in the south-southwest of the Batu Arang depression, probably accompanied by uplift of the northern and eastern portions. Erosion followed and removed deposits laid down in the northern and eastern

portions of the trough, by then raised by the earth movements into the zone of denudation. Crustal readjustments of the type outlined above would account for the remnant of coal measures found at Batu Arang and also for the present general westerly and south-westerly dip of about 14° in the deposits. When formed they would have been deposited almost horizontally.

106. Subsidence of the coastal area, approximately west of a line extending north to south through Batang Berjuntai, appears to have taken place in recent times. The accumulation of sediment to form swamp deposits and coastal alluvium accompanied the subsidence. Workable tin deposits, found at a few localities under this cover are described in paragraphs 108 and 114.

RECENT DEPOSITS.

107. The recent deposits comprise river alluvials and coast deposits. They cover approximately two hundred square miles of the area under survey. Below thirty-five square miles of these alluvials the bedrock has been identified as sedimentary rock belonging to the calcareous series or as granite. This figure of thirty-five square miles has been duplicated by including it also in the figure for the areas occupied by the calcareous series and granite. Most of the river alluvials are tin-bearing in the valley of the Selangor river and its many tributaries draining from the Main Range, and the Batu and Gombak rivers and their tributaries.

108. The coastal alluvium covers most of the country west of a line extending approximately from north to south through Batang Berjuntai; occasional masses of granite and sedimentary rock penetrate these deposits and form small hills. Deposition of alluvium has buried a submerged landscape and boring has indicated that some of the valleys of this landscape are now over one hundred feet below the present surface. North of the Selangor river, limited portions of the swamp area have been tested. The lowest alluvial deposits have been mostly gravel, above which sand occurs and then beds of sandy-clay and clay, and finally swamp deposits consisting of decaying water-saturated vegetation. South of the Selangor river, where the surface drainage is better, peaty soils overlie clay, below which sand and gravel beds have been encountered. In the Batang Berjuntai area workable tin-ore occurs with the lower alluvium, while further west and south-west near the coast small amounts of tin-ore have been recorded in bores sunk for water on Lapan Utan and Raja Musa Estates.

ECONOMIC GEOLOGY OF THE PART OF NORTH SELANGOR COVERED BY SHEETS 3 B/10 AND 3 B/11.

109. The portion of Selangor covered by topographical sheets 3 B/10 and 3 B/11 is one of the most important mineral producing areas in Malaya. The only working coalfield in the country is situated here, the area has a considerable tin output, and recent investigations indicate it to have all the main materials necessary for the manufacture of high grade Portland cement. Small amounts of gold are produced; both ores of tungsten (wolfram and scheelite) occur and have been worked in the past, and the ore of aluminium (bauxite) has been found. Other minerals of economic interest include ilmenite, zircon and monazite. Lateritic iron ore and limonite occur and are used locally for the construction of rubber estate roads and secondary

roads, particularly in the Kuala Selangor district where there are only small supplies of good roadstone. In the east of the area an unlimited amount of good quality granite, suitable for use as both roadmetal and building stone, is available. Two hot springs occur in the eastern portion of the district and their waters are said to be of medical value for skin and rheumatic complaints.

110. *Coal.*—The coalfield at Batu Arang is at present the only local source of coal in Malaya. Since production commenced in 1915, 12,616,390 tons of coal have been obtained from this field. Of this total 11,246,556 tons were worth \$88,536,928; the value of the remaining 1,369,834 tons, produced during the Japanese occupation, is unknown. During 1948, 375,460 long tons of coal were produced valued at \$7,696,930. In addition, firebricks, bricks and tiles, worth \$520,000 were also manufactured from local deposits associated with the coal. A summary of the geology of the coalfield and some details of the prospecting for coal are given in paragraph 103.

111. *Tin-ore.*—During 1948 the tin-ore production from the alluvial beds in the area under survey amounted to 56,874 piculs. No ore was obtained from lodes. A few low grade tin lodes are known to occur in the Main Range granite and in the bordering sedimentary rocks. These deposits, mentioned in paragraphs 101 and 102, were described in paragraph 86 of the 1939 Report. The alluvium, which yields the present tin output, occurs in the valleys of the Selangor, Kerling, Liam, Serendah, Rawang, Choh, Garing, Kuang, Kundang and Lower Batu rivers, all of which rise on the Main Range granite highlands.

The bulk of the tin output in 1948 was obtained by five dredges belonging to the following companies: Rawang Concessions Limited, Rawang Tin Dredging Limited, Berjantai Tin Dredging Limited, Taiping Consolidated (Kundang Section) and Austral Amalgamated Tin Limited (Ulu Yam Section). Southern Kinta Consolidated Limited and Kundang Tin Dredging Limited also have properties in the area but were not dredging during 1948. Part of the properties of the Renong Tin Dredging Company Limited and Selayang Tin Dredging Company occur in the area under survey but these portions were not worked during 1948. In addition to the dredges, seventeen Chinese gravel-pump mines were operating in the area during the year.

112. *The Future Prospects of Tin Mining.*—In the area under survey the future prospects for tin mining are relatively good as far as potential tin resources are concerned. Unpredictable economic and political factors are likely to cause fluctuations in the output similar to those which have occurred in the past.

113. At present the bulk of the tin-ore is obtained from river alluvials and the ground mined averages approximately 0.4 katies of tin-ore per cubic yard. During some years in the past ground averaging as little as 0.25 katies of tin-ore per cubic yard has been worked by one company. It is probable that much of the tin-ore obtained in this area for the next few years will come from river alluvials and will be won from the valleys of the Selangor, Rawang, Serendah, Kundang, Kuang, Liam and Batu rivers and their tributaries. Alluvial tin-ore is known to occur in some parts of the above valleys not mined at present and in the valleys of the Garing, Sembah and Kerling rivers and the swamps where the Sungei Buloh joins the Selangor river; parts of these valleys are likely to repay more extensive testing. Alluvium which may contain workable tin-ore also occurs in the lower valleys of the Tua, Batu, Gombak, Gong, Pedang, Kalong, Batu Balang and Batang Kali rivers.

114. The production of tin-ore from the coastal deposits will probably increase in the future. At present only the tin output of Berjuntai Tin Dredging Limited comes from these beds, but prospecting has already shown workable low grade deposits to the west and north-west of this property. Towards the coast bore holes sunk for water at Raja Musa, Bukit Rotan and Lapan Utan Estates, have revealed sediments carrying small amounts of tin, indicating that in this area ore may be found anywhere below the vast tract covered by coastal alluvium. A point of further significance concerning the potential tin resources is the discovery that the bedrock in the part of this area tested comprises limestone and schist cut by granite intrusions. The bulk of both the alluvial and lode tin deposits elsewhere in Malaya occur in association with rocks of this type; thus tin-bearing intrusions may be found in this area. The alluvial tin-ore that occurs here does not, therefore, necessarily come from the Main Range, but may be derived from local lodes.

115. It is unlikely that all the coastal deposits cover workable tin-ore and present indications are that tin deposits, rich enough to be mined, will be limited to a fraction of the area and will be found in submerged valleys now buried under swamp deposits. The beds will probably contain low grade ore. Part of the area covered by the coastal deposits is thus a possible mining region of the future which should be tested so that the portions not carrying mineral wealth can be developed in other ways. A brief description of these coast deposits is given in paragraph 108.

116. *Cement.*—The main materials required for the manufacture of Portland cement have this year been shown to be available in North Selangor. An obstacle in the past to the manufacture of high grade cement in Malaya has been the high magnesia content of much of the limestone tested. Magnesia has to be below six per cent. if limestone is to be satisfactory for the preparation of cement of this type. This year a representative of the Associated Portland Cement Manufacturers Limited proved an area of limestone south-west of Rawang to be low enough in magnesia and other impurities to be utilised.

The limestone tested occurs below alluvium in the area covered by lots 1,644, 1,724, 462 and 1,860. Some of it is exposed in the workings of Sin Seng Huat Tin Mine in lot 1,644; the remainder is covered by alluvium. Diamond drilling was used to test the area and the magnesia content of the rock was found by chemical tests in the field to average under two per cent. Most of the limestone occurs beneath thirty to forty feet of alluvium but at one locality it is found under weathered graphitic schist at depths varying between ninety and one hundred and fifteen feet. This unusual relationship may be due to part of a bed of schist, interstratified with limestone, having slumped over the remaining rock after limestone in the vicinity had been removed by solution. In the fresh schist pyrite occurs and its alteration products would speed the solution of nearby limestone. If this locality is developed a quarry will be opened up and limestone excavated to a depth of one hundred and fifty feet.

At Kanching, about five miles from Rawang, between 1937 and 1939 the limestone of Bukit Takun was tested by diamond drilling. The bulk of the analyses showed the magnesia and other impurities to be low enough to allow this rock to be used for preparing cement, although the magnesia content varies and occasional patches of rock occur containing up to nine per cent. magnesia. It is estimated that at Kanching about twelve and a half million tons of limestone are available. The limestone at Rawang has the advantage of being nearer the railway and to Batu Arang where shale and coal, also required in cement manufacture, can be obtained.

117. *Aluminium Ore.*—Bauxite, an hydrated oxide of aluminium, was first found in the area under survey on Sungei Choh Estate during 1941; the deposit was described in paragraph 104 of the Annual Report for 1946.

This year bauxite was discovered at Bukit Robinson (sheet 8 B/10) and sporadic occurrences of ore were found over an area extending northwards from Bukit Robinson for a distance of over six miles to beyond Batang Berjuntai. The bauxite here overlies shale and appears to have formed below ferruginous laterite. At the locality from which specimens were obtained, much of the laterite, together with some bauxite, had been removed for roadmetal by the Public Works Department. A sample of bauxite analysed by Mr. W. A. Tooke contained:

Al ₂ O ₃	60.0	per cent.
SiO ₂	6.4	"
Fe ₂ O ₃ and TiO ₂	3.8	"
Loss on ignition	29.8	"

Total	100.0	"
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Unfortunately bandit activities have prevented the testing of the extent of the deposits. The mode of occurrence of the aluminium ore appears to be similar to that in south-western Johore, where aluminium deposits were mined by the Japanese prior to 1942.

118. *Gold, Tungsten and "Amang".*—Other mineral resources comprise gold and tungsten, also dumps of "amang" containing ilmenite and small quantities of zircon and monazite.

Gold was recovered up to 1942 in small quantities as a by-product from dredges mining tin-ore, but none was recorded as being produced in 1948. No parent gold-bearing bodies have been located and there are no alluvial deposits sufficiently rich to be mined for gold alone.

119. Tungsten occurs in the area under survey both as wolfram and scheelite. No ore was produced in 1948. The mode of occurrence and distribution of the deposits is described in paragraphs 102 and 103 of the 1946 Annual Report.

120. "Amang" heaps in the area under survey total approximately twenty-five thousand tons. Dumps containing about seventeen thousand five hundred tons have been surveyed on the following dredging properties: Berjuntai Tin Dredging Limited, Rawang Concessions Limited, Rawang Tinfields Limited, Taiping Consolidated Limited and Austral Amalgamated Tin. The "amang" consists mainly of ilmenite and the above dumps contain between seventy per cent. and ninety-three per cent. of this mineral. A little monazite is usually present and up to one and a half per cent. has been recorded in some of the dumps. The zircon content is generally between 1½ per cent. to 3½ per cent.

GENERAL ECONOMIC WORK.

121. Considerable economic geology, mostly in parts of Selangor outside the area under detailed survey has been carried out during the year and numerous enquiries answered. Investigations and work have been undertaken for the Public Works, Electrical, Agricultural, Mines and Police Departments. The more detailed investigations are summarised below.

INVESTIGATIONS OF DAM SITES IN THE
KUALA LUMPUR AREA.

122. Sites suitable for a large dam in the vicinity of Kuala Lumpur to supplement the town's water supply have been investigated during the year. This work has been carried out at the request of the Public Works Department and the investigation has been made in co-operation with Mr. McClure, Senior Executive Engineer, Waterworks. The first site examined is on the Sungei Gombak about thirteen miles from Kuala Lumpur in the area covered by topographical sheet 3 B/11. The dam proposed for this locality is estimated to be capable of supplying fifteen million gallons of water per day. The other site tested is at Klang Gates about eight miles from Kuala Lumpur in the area covered by topographical sheet 3 B/15. If this site proves suitable a dam retaining about three thousand million gallons of water will be constructed. Work on the Sungei Gombak site has been discontinued; the examination of the Klang Gates site is proceeding.

123. *The Sungei Gombak Site.*—The proposed site on the Sungei Gombak consists of granite which has been affected by tropical weathering known elsewhere in Malaya to penetrate to depths of over one hundred and fifty feet. The rock is jointed and faulting and shearing, known in the surrounding district, might be encountered at this locality. These are factors adversely affecting a dam site, thus careful investigation is necessary. The testing of the site by the Public Works Department commenced with pitting of the valley floor which was found to be satisfactory, fresh granite occurring approximately fifteen feet below the surface. Testing of the lower slopes of the valley however, showed an increasing thickness of weathered rock and overburden and it is possible that fresh rock does not extend to the five hundred and fifty-foot level in the valley sides, which it is proposed the top of the dam should reach. Work has not been continued beyond this stage; should the investigation be resumed upper portions of the valley sides should be tested to see whether hard rock extends to the height which it is proposed the dam should reach.

124. *The Klang Gates Site.*—The possibility of building a dam at Klang Gates is at present being investigated. The site is in the Klang river valley and lies between the two tunnels on the road to Kuala Selh. The investigation of this locality is of particular interest from both the geological and the engineering aspects, since, as far as can be ascertained, no large dam has yet been constructed in a setting of this type.

125. The rock on the proposed dam site is mainly vein quartz and is part of a quartz reef known to extend for over ten miles and to widen in places to as much as two hundred yards. This intrusion trends approximately from east to west and cuts granite; most of it consists of massive white quartz broken however by fractures and joints. Cutting the massive quartz are a number of elongated, irregularly-shaped cavities most of which are lined with interlocking quartz crystals. The vein

quartz is almost pure silica (silicon dioxide); specimens tested chemically a number of years ago contained 0.02 per cent. of the iron sulphide pyrrhotite and traces of both scheelite and tin-ore.

The reef is believed to have originated as follows. The quartz is genetically related to the Main Range granite, the emplacement of which was accompanied by severe earth movements. The intrusion of quartz took place after the granite had solidified and probably occurred along a line of weakness through this rock. The quartz intrusion is probably a composite body. The cooling of the quartz vein appears to have been accompanied by shrinkage which produced fractures, into which residual siliceous solutions penetrated and solidified to form small veins and quartz crystals which line most of the larger fractures and cavities. These fractures generally trend parallel to the length of the reef; others, mainly formed at a later date, cut across the reef. There are indications that the reef is not one continuous mass of quartz but consists of lens-shaped quartz bodies with ramifying veins penetrating intervening, partly assimilated, silicified granite.

The reef forms a conspicuous topographical feature with numerous white cliffs. It rises high above the level of the surrounding granite country owing to the quartz having a greater resistance to weathering. The proposed dam site is the deep gorge followed by the small Klang river through this hard, insoluble quartz. The very presence of the river indicates a possible line of weakness across the reef at this locality. The cause of the river cutting the reef at this particular place is uncertain and several explanations are possible. The most probable is that the quartz mass narrows to give place to an area of granite impregnated with siliceous material and cut by a network of quartz veins. Pitting, carried out in the gorge area during 1948 by the Public Works Department, indicated the quartz mass to have split into two main veins with numerous small, ramifying stringers. It is also possible that the river has followed, and scoured out, a narrow zone of weakness along a series of close joints cutting the quartz. A further possibility is that faults occur at this locality, for there is an apparent displacement of the reef southwards on the east side of the gorge, but as yet no definite fault planes or sheared rock have been found and the apparent displacement could be equally well explained by a local flexure in the intrusion.

An unusual feature of the river in the gorge area is the absence of waterfalls or rapids, the river flowing through a deep, sandy-bottomed channel at places where massive quartz would be expected to outcrop. If the river follows a fault or closely jointed zone it would explain this anomaly. Another possibility which would also explain this peculiarity, is that river capture has reduced the flow of water and caused silting of this part of the valley. It is also possible that an accumulation of debris below the gorge is the cause. Either of the above would give a decreased rate of flow and would explain the alluvial deposits which occur in the valley.

126. A shaft is being sunk in the floor of the valley and the sides are also being tested. The steep gorge faces have been cleared of vegetation and some pits have shown fresh rock to extend to the height the dam is likely to reach.

Klang Gates is a possible dam site but this has to be treated with suspicion until all factors proving its suitability for the construction of a dam have been established. Considerable testing is likely to be required before this site can be proved to be satisfactory for the construction of a large dam.

127. THE SITE OF THE ELECTRICAL POWER STATION AT CONNAUGHT BRIDGE, KLANG.—A portion of the site of the proposed power station at Connaught Bridge, Klang, was investigated for the Electrical Department. The site is about two and a half miles upstream from the town of Klang and comprises lots 1,405

and 1,406 in the areas covered by eight chain sheet 91D. The area was bored by the Electrical Department with the object of testing whether or not the site was suitable for foundations supporting heavy electrical equipment. A Banka type drill was used as a diamond drill was not available.

128. The following sediments and rocks were found in the order shown. Alluvial mud and soft clay occur in the river valley and rest on sediments comprising beds of sandstone and stiff clay, below which there is quartzite.

The sandstone and stiff clay are perhaps compacted bands of alluvium or may be older deposits, possibly of a similar age to the coal measures at Batu Arang, Selangor. There is also the remote possibility that these may be weathered rocks of Triassic age. Similar beds of sandstone and stiff clay, in which unidentifiable fossil fragments were found, occur below Belfield Bridge, Klang. The deposits at the Power Station site are described below in their stratigraphical order:

- (a) Alluvial mud and soft clay carrying fragments of decayed vegetable matter. This material was found in holes put down in the river or in the low-lying swampy ground in its immediate vicinity and is a recent river deposit. Its average thickness is forty-five feet; the minimum thickness, eight feet, was found in the river.
- (b) Consolidated sediments comprising beds of friable sandstone and stiff compacted clay underlie the recent alluvial deposits described above. The clay gets stiffer as depth increases and the sandstone generally, but not always, becomes more compact. There are indications that these beds may be dipping at a moderately steep angle but this could not be determined for certain. In one hole water under pressure rose from a bed of gravel encountered between forty-two and forty-three feet below the surface.
- (c) Quartzite, believed to be of Triassic age, was met in two bore holes. There are indications that an irregular surface of this rock underlies the sediments described above. It is, however, possible that the quartzite fragments were chipped from boulders and that the sediments described in (b) persist to a greater depth, or they may represent weathered portions of Triassic rocks.

129. POTTERY.—During the year Goh Ban Huat Pottery Works have experimented with a mixture of kaolin from the Kuala Lumpur area and the plastic clay they normally use which comes from Johore. This mixture has produced an improved quality of pottery. Experiments in the making of porcelain using felspar from a pegmatite at Kalumpang in Ulu Selangor, and local kaolin were also carried out and yielded good results.

PROGRESS REPORT ON GEOLOGICAL WORK NEAR KUANTAN, PAHANG, BY FREDK. H. FITCH, GEOLOGIST.

130. In the early part of the year, two visits were paid to the Pahang Consolidated Company's mines at Sungei Lembing where outlying mines which were not working immediately before the war were examined. Raised beaches north of Tanjong Gelang were traversed in February. Later in the year, jungle trips were made to Sungei Endan, Sungei Taweh, Sungei Riau, and Ulu Sungei Reman. Rock collectors made an independent trip from the latter to Pasir Kemudi by way of Sungei Rengoi and Sungei Batu, and another from Sungei Longkang to the northern tip of Jabor Valley Estate by way of Ulu Sungei Riau.

The months of July, August and September (except for a few days spent at Bukit Besi, in Trengganu, where an examination of the iron-ore deposits was made for Messrs. Eastern Mining and Metals Co. Ltd.) were devoted to the raising of Special Constabulary in Kuantan and Sungei Lembing.

131. The first draft of almost half the memoir on the Pahang portion of Topographical Sheets 2 P/13, 2 P/14, 3 D/1, 3 D/2 and part of 3 D/5 has been written, and maps and diagrams prepared for publication in that memoir. (For progress reports on the geological mapping of this area, *see* below and Reports of the Geological Survey Department for the years 1939, paragraphs 56 to 62; 1940, paragraph 40; 1946, paragraphs 154 to 171; and 1947, paragraphs 86 to 112.)

THE AREA MAPPED ON TOPOGRAPHICAL SHEETS
2 P/13, 2 P/14, 3 D/1, 3 D/2 AND PART OF 3 D/5 IN 1948.

132. *Sungei Endan, Sungei Taweh and Sungei Riau.*--- Quartzite, shale and conglomerate are the dominant rocks of the area drained by Sungei Endan, Sungei Taweh and Sungei Riau. Red shales, associated with conglomerate on Sungei Endan, contain fragmentary material which may be of volcanic origin. Crinoidal chert was found in a tributary of Sungei Endan.

133. On Sungei Taweh, another small area of granite was discovered, additional to the three mapped before the Japanese occupation. Most of the concentrates from Sungei Taweh are rich in cassiterite but, so far as is known, no prospecting of that river has ever been carried out. Should the alluvium prove to carry payable values, several areas of flat land in the middle reaches of the river are suitable for gravel pump mining, and it is possible that a dredging area might exist farther downstream if the cassiterite has travelled so far. No cassiterite was found in the tributaries of Sungei Riau draining Bukit Ketam although the granite of that hill is in places copper-stained, suggesting that some mineralisation has taken place.

134. As quartzites are abundant and conglomerates occur sporadically, the sedimentary rocks underlying the greater part of the drainage basin of Sungei Endan, Sungei Taweh and Ulu Sungei Riau are believed to be part of the Arenaceous Series of presumed Triassic age. In this area, the only fossils found were poorly preserved leaves from Sungei Taweh, resembling those collected from Balok Forest Reserve (*see* paragraph 136), and casts of crinoid columnals in chert from Sungei Endan.

The sand of the bed and banks of Sungei Taweh is of uniform fine grade and samples, on testing, have proved to be suitable as a moulding sand for foundry work.

135. *Ulu Sungei Reman.*---Blocks of tourmaline granite and gneiss are common in the bed of Sungei Reman for three miles from its source. The river flows over biotite granite porphyry in its upper reaches. Stream concentrates show that cassiterite is abundant and that other detrital minerals present include tourmaline and pink garnet.

The remainder of the valley of Ulu Sungei Reman and of the drainage area of its tributaries Sungei Burong, Sungei Rengoi and Sungei Batu, is built of typical Lower Carboniferous shales with subordinate quartzite; no conglomerate was observed.

A few poorly preserved fossils were found in Ulu Sungei Rengoi. Plant remains are exceptionally abundant in shales on Sungei Reman between Kuala Sungei Anak Reman and Kuala Sungei Rengoi.

A foraminiferal limestone was collected by Che Kamaruddin bin Osman, rock collector from the Sungei Rengoi close to Kuala Sungei Burong and is described in paragraph 138.

FOSSILS.

136. Fossil plant from shale bands of the Arenaceous Series in Balok Forest Reserve were examined by Dr. W. N. Edwards, Keeper of Geology, British Museum (Natural History), London, who reported them to be "stems" up to 4 cms. in diameter and very fragmentary pieces of frond. They are not well enough preserved to be referable to any species and Dr. Edwards wrote of them "I do not think it would be wise to base any estimate of the age of the rocks on these fragments alone. I can only say that I should be surprised if they were Triassic, and should rather expect them to be Upper Carboniferous or Permian". The age of the Arenaceous Series near Kuantan is thus left in doubt but these rocks are being included, on lithological grounds, in the Triassic until more palaeontological evidence is available.

137. Brachiopoda and other fossils from Lower Carboniferous beds near Sungei Lembing have been identified by Dr. Helen Muir-Wood of the British Museum. Most of the fossils are of the same species as were described by her in "Malayan Lower Carboniferous Fossils". Two additional species were found in a collection, from Sungei Terapai, which had been temporarily retained in Batu Gajah before the Japanese occupation and had since been sent to London. A large fauna from a locality near Gakak Mine, discovered by Mr. F. H. Way of the Pahang Consolidated Company Limited, is of approximately the same age as that from Sungei Terapai.

138. The new identifications made by Dr. Muir-Wood are listed below:

Sungei Terapai.
Specimen No. 14897.
Age: Visean (Lower Carboniferous).
Matrix: Shale.
Productus sp.
Posidonia sp.
(These species are additional to those listed in Report of the Geological Survey Department for the year 1947, paragraph 109).
Sungei Balang, about 2 miles from Kuala.
Specimen No. 15882.
Age: Visean.
Matrix: Shale.
"*Poteriocrinus*" sp.
Euomphalus sp.
Posidonia sp.
Chonetes sp.
Productus (sensu stricto).
Pustula sp.
Dictyoclostus sp.
Punctospirifer pahangensis Muir-Wood.
Sungei Balang, at edge of topographical sheet 2 P/13.
Specimen No. 15886.
Age: Lower Carboniferous, probably Visean.
Matrix: Shale.
Parallelodon cf. *bistriatus* (Portlock).
Scaldia sp.
Edmondia sp.
"*Poteriocrinus*" sp.
Fenestella sp.
Fenestella cf. *plebeia* M'Coy.
Euomphalus sp.
Schizophoria sp.
Rhipidomella sp.
Emarginifera sp.
Linoproductus sp.

Productus sp.
Echinoconchus elegans (M'Coy).
Echinoconchus sp.
Krotovia aculeata (Martin).
Avonia sp.
Dictyoclostus sp.
Plicochonetes cf. *buchiana* (de Kon).
Chonetes sp.
 Productid, Spiriferid and Athyrid.
 Echinoid interambulacral plate cf. *Melonechinus*.
 Road section between Sungei Perong and Sungei Gakak, near
 Gakak Mine.
 Specimen No. 16678.
 Age : Visean.
 Matrix : Shale.
 "*Poteriocrinus*" sp.
Euomphalus sp.
Yunnania sp.
Fenestella sp.
Schizophorus sp.
Chonetes sp.
Dictyoclostus sp.
Buxtonia sp.
Productus sp.
Punctospirifer pahangensis Muir-Wood.
Hustedia cf. *carbonaria* (Phill.).
 ? *Crurithyris* sp.
 A trilobite.
 Plant fragments.
 Isolated limestone pinnacle at south end of Bukit Charas.
 Specimen No. 16679.
 Age : Visean.
 Matrix : Limestone.
Krotovia multituberculata (Yanishevsky).
Dictyoclostus cf. *multispiniferus* (Muir-Wood).
Linoproductus tenuistriatus (de Verneuil).
Brachythyris willbourni Muir-Wood.
Brachythyris kokeucensis (Dikareva).
Fenestella sp.
 Rhynchonellid.
 A black limestone containing foraminifera and fragments of bryozoa.
 Foraminiferal limestone. S. Rengoi close to K. Sg. Burong.
 Specimen 17859.
 Age :
 Mr. C. D. Ovey of the British Museum reported as follows :
 "Upon examination, the contained foraminifera strongly
 suggest that the presumed Visean age of the material is correct.
 This opinion has been confirmed by Mr. A. G. Davis who also
 discovered the alga *Koninckopora* sp. in one of the thin sections.
 This genus is always very abundant in the Visean.
 The foraminifera are :
Hemigordius aff. *hartoni* Cushman & Waters.
 Pennsylvanian (fig. 1).
Archaeodiscus karreri Brady Lower Carboniferous (fig. 2).
Endothyra aff. *bowmani* Brady (non Phillips).
 Carboniferous (fig. 3).
 Pennsylvanian (fig. 4).
 Visean (fig. 5).
 ? *Millerella* sp.
Cribrostonium sp.
 and another early fusuline belonging to the subfamily Fusulininae."

MINES OF THE PAHANG CONSOLIDATED COMPANY LIMITED.

139. The following notes are on mines which were not
 working during the writer's visits to the area before the Japanese
 occupation.

140. *Gakak Mine.*—This mine lies near Kuala Sungai Gakak, two miles south-east of Sungai Lembing. The opencut is on a fault zone (here called Gakak fault) striking roughly northwest-southeast; Gakak lode lies entirely on its eastern side. Near the fault, where the lode strikes 60 degrees east of north, it carries its highest values and has its greatest stopping width of almost twenty feet; the cassiterite is stated to be in the walls of quartz veins and not in quartz itself. Three hundred feet east of Gakak fault, where the lode channel swings to a north-south strike, it carries a quartz vein with practically no associated tin values.

In this vein there is clear evidence of two generations of quartz, the older now shattered and ironstained, the younger pure white, unshattered and often containing crystalline vughs. The lode is cut and displaced by several faults parallel with Gakak fault, some of which carry quartz. The lode channel is everywhere parallel with the strike of the shale country.

141. *Gakak Creek Mine.*—This mine is more than half a mile south-east of Gakak mine. Gakak fault, if it extends so far, would be expected to pass through the western part of the workings on adit level; shears with a north-west strike there may be related to it. Gakak Creek lode strikes east-west and is a mineralised shear zone, in places more than fourteen feet wide, with a persistent vein of vughy quartz, similar to the younger generation of that mineral in Gakak lode, on the footwall.

In part of the stope above adit level, sulphides are much more abundant than in other workings, and secondary copper minerals are common in the mine.

142. *Waterfall Mine.*—The workings in Waterfall Mine are a mile west of Gakak Creek, on an isolated lode which strikes roughly east-west and has been stoped above adit level. This lode has pronounced hanging and foot walls, with gouge on the latter.

A strong north-west fault was cut in a development end about 700 feet from the adit mouth; it may be comparable, in its origin and effect on mineralisation, with Gakak fault and the major transcurrent faults of Willinks Mine.

143. *Jeram Batang Mine.*—In this comparatively uninteresting mine which occupies an isolated position more than half a mile north-east of Sungai Lembing, the main lode varies in dip from 40 to 85 degrees to the north and strikes parallel with the dip of the shale country (c.f. Gakak lode).

144. *Gunong Mine.*—This mine is in the upper part of Bukit Batu Puteh, behind the power station at Sungai Lembing and just south of the workings in Willinks East Section. Weathering in the lodes and their vicinity has been so strong that extensive timbering is required and sills have frequently to be placed below drive timbers to prevent them sinking into the floor. Lodes are very irregular, often persisting for only twenty or thirty feet and not traceable from one level to an intermediate one only 40 feet above. They dip either north or south, sometimes both in parts of the same lode, and have dips as low as 20 degrees. The lode system, which extends for a length of more than a thousand feet, thus appears to be a mineralised shatter zone. Some of the lodes

are exceptionally rich, one recently worked carrying more than eight per cent. tin although in places only six inches wide.

Quartz is scarce in the ore which consists largely of cassiterite set in white or ironstained clay. Elsewhere in the mines, cassiterite is associated mainly with chlorite and it is therefore thought that this white clay may have been derived from that mineral by leaching by acid sulphate-bearing meteoric waters flowing through lodes in which sulphide minerals are being oxidised. Corroborative evidence of this was later found in Kabang lode where specimens showing stages of this leaching were collected.

BUKIT BESI IRON MINE, TRENGGANU.

145. The iron ore deposits of Bukit Besi, Trengganu, formerly worked by the Japanese, were examined for Messrs. Eastern Mining and Metals Co. Ltd., who now own them. The ore, for descriptive purposes, may be divided into four types:

- (a) *Primary Massive Ore*.—The principal constituents of this are hematite and magnetite in varying proportions, the former usually predominating. It forms masses at least as large as 800 feet long by 100 feet wide. The abundance of martite (hematite pseudomorphs after magnetite crystals) suggests that the ore was, to a large extent, initially deposited as magnetite. A further change to secondary limonite is common along joint planes in the massive ore.
- (b) *Friable Ore*.—This was seen in quantity only in an adit although it also occurs in outcrops on some of the benches. It consists of finely granular iron ores, loosely compacted.
- (c) *Boulder Ore*.—This consists of fallen blocks from the outcrops of massive ore and has the same composition except that limonitisation has usually proceeded further.
- (d) *Limonite Ore*.—This was included by the Japanese in "boulder ore" but is here separated as it had a different origin. Concretions of secondary limonite, mostly an inch or two in diameter, are very abundant in the soil and sub-soil over almost the whole developed surface of the hill.

They have been deposited from iron-bearing ground water and their distribution is so widespread and even that it is considered unlikely that the iron could have been derived entirely from the resistant and sporadic outcrops of primary massive ore. The major source of iron in the ground water may have been the more easily weathered friable ore; in which case, that type of ore, which does not produce topographical features, may be more widespread than is suggested by surface outcrops.

146. The ore-bodies occur in both granite and shale country and, in a general way, are near the contact between those two rocks. It therefore seems reasonable to assume that the ore is genetically connected with the granite.

PROGRESS REPORT ON GEOLOGICAL WORK IN SOUTHERN TRENGGANU BY A. C. AMIES, GEOLOGIST.

147. After my arrival in Malaya at the end of May three weeks were spent in Batu Gajah before proceeding to Chukai, Southern Trengganu.

The next two months were spent establishing an office, visiting various mines in Southern Trengganu and mapping in the immediate vicinity of Chukai (2 P/14).

In October, Ulu Besut and Ulu Stiu were visited in the company of the Inspector of Mines, Trengganu, and the Administrative Officer, West, in connection with the alienation of land in the headwaters of the Besut River. The Besut Valley is the centre of a major irrigation scheme, so it is most important to consider the effect of any present or future mining on the volume of silt deposited in the Besut River. The probable amount of future mining cannot be finally estimated, however, until a detailed geological survey of the area has been carried out.

After attending the Annual Conference at Batu Gajah, further mapping in the vicinity of Chukai was done.

GEOLOGICAL SURVEY OF 2 P/13 AND 2 P/14 IN SOUTHERN TRENGGANU.

148. Very little has been accomplished in the systematic mapping of 2 P/13 and 2 P/14. Except for one short trip to Bundi most of the work has been carried out in 2 P/14. Traverses have been made along the main roads, along the Kemaman River and rock exposures in the neighbourhood of Chukai have been examined.

149. The rocks making up the isolated hills rising above the coastal alluvium near Chukai belong to the Arenaceous Series—quartzites, sandstones, fine-grained conglomerates and carbonaceous shales—usually striking in a north-south direction. Interbedded with this series are rocks of the Pahang Volcanic Series consisting of white and pink rhyolites and rhyolitic tuffs.

150. At Tanjong Mat Amin and at Sungei Awang near Kuala Kemaman, plant fossils have been collected from black carbonaceous shales. The fossils have been sent to the British Museum in the hope that the age (Triassic or Carboniferous) of this Arenaceous Series may be determined.

151. The carbonaceous shales have been intensely folded and where the folding movements have been most intense the rocks are converted into graphitic shales. At Bukit Kuang about a mile north-west of Tanjong Mat Amin, poor quality amorphous graphite was mined by the Japanese during the occupation period.

152. Along the Ayer Puteh Road from Chukai rocks of the Arenaceous Series are found as far as the 18th mile post where biotite granite outcrops. The rhyolite and rhyolitic tuffs of the Pahang Volcanic Series outcrop at the 1½ mile post, Ayer Puteh Road; at Bukit Mentok 1 mile south-west of Chukai township; and at Kampong Olong on the Kemaman River.

153. Rocks of the Argillaceous Series have been seen at Bundi. They outcrop at gravel pump No. 1, south-east of Bukit Bundi and consists of spotted hornfels, banded shale and limestones containing chert nodules. No macroscopic fossils have been seen in the limestone. The series is intruded by biotite-chlorite granite. Some shearing of the granite has taken place at the immediate contact. A dyke of augite porphyrite cuts the granite in the Sungei Chenah close to Bundi township.

154. Mineralisation has taken place near the granite-hornfels contact, producing tin lodes associated with quartz-chlorite gangue, a lodge of mixed sulphides and a stockwork of veins (each a few mms. wide), iron sulphide predominating.

155. Along the Besut valley in Northern Trengganu rocks of the Arenaceous Series are exposed along the Besut River from Pasir Akar to Kampong La and as far as Sungei Diolok in the Sungei Ayer Hangat. They are found along the S. La as far as Lata Teras and on the track from Kg. Dengir to Sungei Apoi as far as Bt. Tangga. They consist of quartz grits, quartzose conglomerates, quartzites and shales. At Tanjong Batu about three miles above Pasir Akar a tuffaceous agglomerate outcrops on the northern bank of the river.

At about half a mile from area under M.C. 27 quartz grits are in contact with coarse porphyritic biotite granite showing conspicuous phenocrysts of pink feldspar. Samples of this granite when analysed yielded 0.2 per cent. tin. At Lata Parit on the S. La a series of dolerite dykes, usually about 2 feet in width, cut the granite. At Lata Teras a modification of the main igneous intrusion has produced quartz diorite.

156. On the way to Ulu Besut via Ulu Stiu the following geological features were observed. Rocks of the Arenaceous Series are intruded by gabbro at Bukit Perachok and medium-grained biotite granite from Bukit Kambing to Kuala Diolok. A post-granitic dolerite dyke (1 foot in width) outcrops at Lata Perdana in the S. Ayer Hangat. In both Ulu Stiu and Ulu S. La, in contrast to Southern Trengganu, there is little evidence of mineralisation near the contact between the granite and the sedimentary rocks.

ECONOMIC GEOLOGY.

157. All the important mining in Trengganu is at present confined to the southern portion. Tin-ore is being produced at Bundi, Kajang-Kemaman, S. Ayam, Jeram Tujoh, and small mines in Ulu Dungun; wolfram at Chendrong; and iron-ore has been shipped from Bukit Batu Besi, Dungun. Of the two mines working at the present time within the area of 2 P/13 and 2 P/14—Bundi and Chendrong—it has been possible to visit Bundi only.

The iron mine at Bukit Besi, Dungun, was visited in the company of Mr. F. H. Fitch, Geologist, Kuantan. The former Japanese mines at Machang Stahun and Bukit Kurang have been examined as well as the alluvial tin mine at S. Apar, Ulu Besut. It is hoped that it will be possible to visit Chendrong, S. Ayam and Kajang-Kemaman in the early part of next year.

158. *Bukit Besi, Dungun.*—The Eastern Mines and Metals Company Limited is at present interested in this iron mine, formerly owned by a Japanese company, The Nippon Mining Company. No mining has been carried out as yet, the company at present being engaged in shipping ore from ex-Japanese dumps and in rehabilitating the mine itself. During the year about 70,000 tons have been exported.

159. *Bundi Tin Mine.*—Five gravel pumps are at present being worked by the Teck Loong Mining Company Limited in the alluvium of both the Chenah and Bundi valleys. The alluvium is made up of boulders of hornfels and quartz in a matrix of fine grey sand. The depth of the alluvium worked

varies from about 15 feet to 50 feet. No work is at present being carried out in the lode area formerly owned by the Freda Tin Mining Company Limited. The average monthly production for this year has been 348.47 pikuls.

160. *Kajang-Kemaman (1925) Ltd.*—This tin-lode mine is working in the shale near a granite-shale contact. The ore mined contains on the average 3.0 per cent. tin and grab samples have been collected with as high as 25 per cent. tin. The average monthly production for this year has been 152.80 pikuls.

161. *Sungei Ayam Concession.*—This tin-lode mine employing a small labour force produced on the average 3 pikuls per month.

162. *Chendrong Wolfram Mine.*—This mine employs about 20 men working a lode containing wolfram in schist country and produces on the average about 20 pikuls per month.

163. *Former Graphite Mine, Bukit Kuang.*—A report on this Japanese mine has already been published in the Annual Report of the Geological Survey Department 1946. From the examination of the surrounding quartzites and carbonaceous shales it is fairly certain that graphite produced by the metamorphism of these shales is concentrated along zones of intense folding. Folding took place about the same time as quartz veins were injected and the heat emanating from these veins may have caused thermal metamorphism.

164. *Former Iron-Manganese Mine at Machang Stahun.*—There is little to add to the report published in the 1946 Annual Report. Over most of the property slumping and secondary jungle conceal the former workings. The steeply dipping lodes at Minimayama close to the Ayer Puteh road have been nearly worked out and practically all mining equipment removed.

165. *Mine at Sungei Apar, Ulu Besut.*—This small mine situated near the Trengganu-Kelantan boundary and worked under M.C. 27, produces about 6 pikuls per month. Work is being carried out in an alluvial flat overlying granite in a high valley above the rapids of Sungei La.

MINOR OCCURRENCE OF MINERALS.

166. The following minerals have also been noted in the area under survey:

Limonite.—Besides the large amount of limonite at Bukit Besi, Dungun, limonite derived from the weathering of magmatic iron oxides has been observed near pump No. 1 at Bundi and in adits in Bukit Bundi.

Ilmenite.—Ilmenite is present in the "amang" dumps at Bundi, Kajang and S. Ayam. At Bundi it is associated with a good deal of iron sulphide. There are not sufficient dumps of "amang" in this area, where carrying costs would be high, for the ilmenite to be saleable.

Zincblende.—Zincblende is the most common constituent of the "Sulphide Bar" Bundi composed of mixed sulphides and good specimens can be found in small dumps near the mill.

Arsenopyrite.—Arsenopyrite has also been observed in samples of the ore from the same locality.

Gold.—A few grains of gold have been collected recently from a gravel pump at Bundi. Gold is also reported to occur in alluvium in S. Pelong, a tributary of S. Nerus, but has not so far been proved to occur in economically workable quantities.

CHEMICAL LABORATORY.

167. Owing to Mr. Harral being on leave, for only one-third of the year were the two Chemists on duty together.

The total number of determinations carried out increased from 569 in 1947, to 878 during 1948. The majority were quantitative analyses with a few qualitative indentifications, screening analyses, magnetic separations, etc. Seven hundred and five were required by the General Public and the remaining 173 were for Government.

General Public.—Tin was determined in 397 samples of ore and/or amang, titanium in 30 samples of ilmenite and tungsten in 29 samples of wolfram. Gold assays in parent rock amounted to 20 and bullion assays numbered 7. Alumina and silica were determined in 110 samples of bauxite and a further 8 were analysed completely. Twenty-two sieving tests were done on tin-ores and "amangs" and 19 magnetic separations were carried out. The remaining 72 samples were miscellaneous and included analyses of brass, bronze, battery plates, bat guano, galena, stibnite, speiss, water and determinations of such individual constituents as arsenic, thoria, tantalum and niobium. Three of the samples from Kramat Pulai Ltd. were interesting in that they were unusual. They are mentioned in paragraph 13.

Mines Department.—Of 114 determinations done, 50 were tin-in-ores and/or amangs, 22 were arsenic in pyritic ores before roasting, 16 were tungsten in wolfram and/or scheelite while the remainder were miscellaneous determinations of gold, antimony and titanium and identifications of haematite, pyrite, copper-lead matte, native bismuth and metallic silicon. The suspended matter was determined in 5 samples of mine effluent.

Other Government Departments.—The tin was determined in 10 export samples submitted by the Customs Department and 7 samples of haematite were identified. The Police Department sent in 13 samples of alleged stolen property: 8 were tin-ores and 5 were gold-ores, all of them being of good value. For the Railways Department the carbon was determined in 2 samples of high speed tool steel in connection with the heat treatment process, one sample of alleged nickel steel was shown to contain no nickel and a sample from a storage battery plate was analysed.

For the Director and Field Geologists 27 miscellaneous analyses and identifications of specimens were carried out.

All tests for radioactivity in ores from the Mines and Customs Departments were done in these laboratories.

BATU GAJAH,
24th February, 1949.

F. T. INGHAM,
Director, Geological Survey,
Federation of Malaya.

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INTELLECTUAL

MALAYAN UNION

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Report of the Geological Survey Department for the year 1946

BY

F. T. INGHAM,

Director, Geological Survey, Malayan Union.

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MALAYAN UNION

Report of the Geological Survey Department for the year 1946

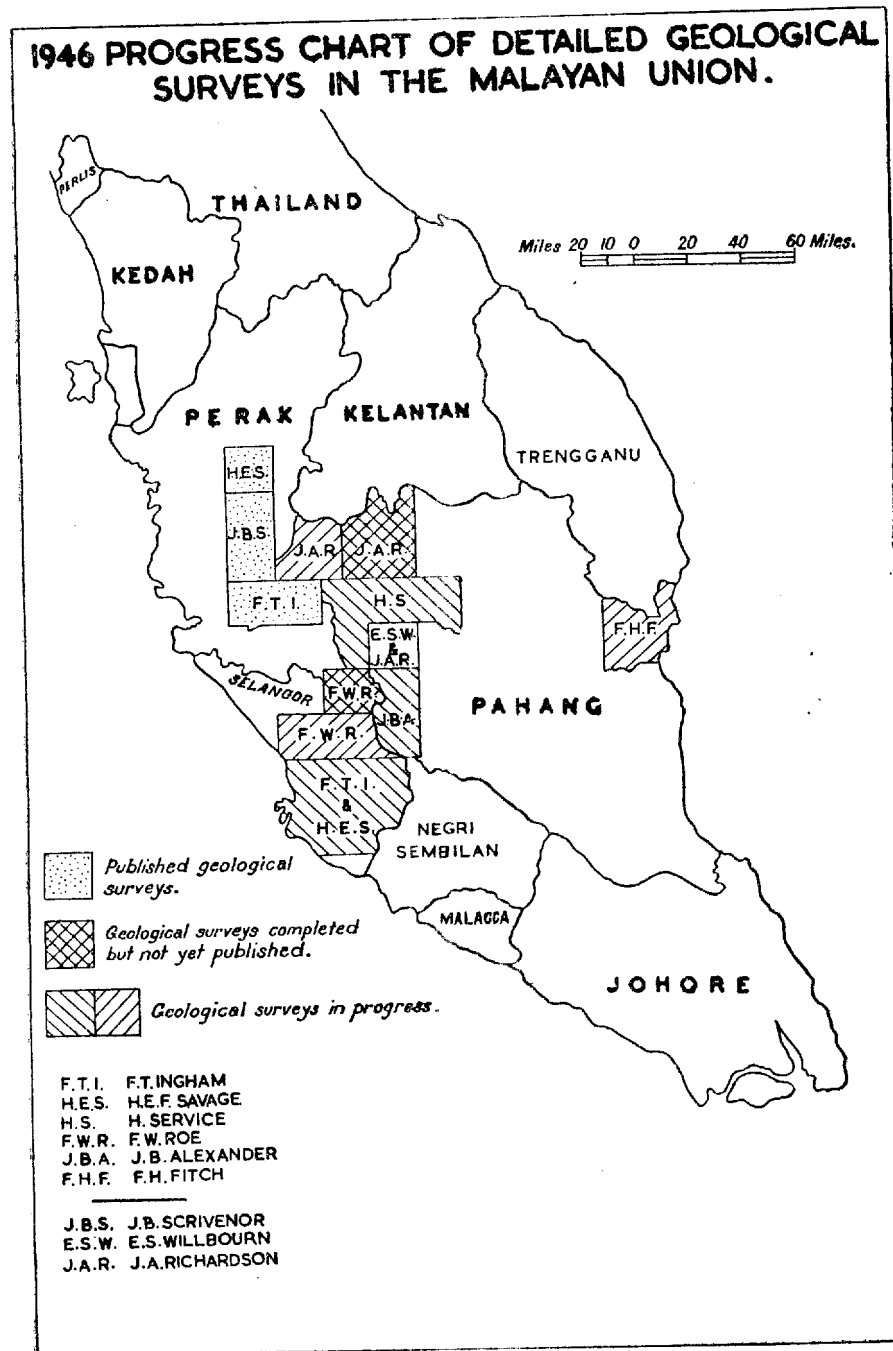
BY

F. T. INGHAM,

Director, Geological Survey, Malayan Union.

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MALAYAN UNION.

REPORT OF THE GEOLOGICAL SURVEY DEPARTMENT FOR THE YEAR 1946.

INTRODUCTION.

1. Owing to the Japanese War no annual report of the department has been published since 1940 when an abridged confidential report was printed. This present report contains some of the unpublished geological information obtained during 1940 and 1941 and that acquired during 1946. Field work was restricted during 1941 as all Senior Officers and many of the subordinate staff were engaged on work connected with the war effort. Major E. S. Willbourn was Deputy Commissioner of the Perak Local Defence Corps and later was attached to the Australian Forces. Captain F. T. Ingham was adjutant of the Selangor Local Defence Corps. Captain H. Service was Station Staff Officer. Members of the Volunteer Forces included Lieutenants J. A. Richardson, W. A. Tooke and F. H. Fitch. Mr. G. M. Harral was Chief Observer, Perak, Observer Corps, and Mr. J. B. Alexander was with the Passive Defence Service. All these officers were Prisoners of War or Internees. Pilot Officer F. W. Roe saw service in Malaya and Sumatra and returned as Major in the Indian Army with the first occupational troops.

2. During the Japanese occupation the department did not function on pre-war lines but the chemical laboratory at the headquarters in Batu Gajah was used by the Japanese until about two months prior to their surrender. Japanese geologists, attached to various mining companies, used the head office to a small extent for reference purposes. There was a total loss of scientific equipment, including microscopes, photographic apparatus, motors and chemical requisites, but fortunately the records in headquarters did not suffer as heavily as might have been expected. The greater portion of both the library and the collection of prospecting files remained intact. The majority of the registered specimens of rocks and minerals were also left, although nearly 5,000 microscope slides were broken or missing. The Japanese during the early part of 1942 attempted to burn down the main office and after the Japanese surrender attempts to loot were made, but both attempts were prevented by the efforts of Mr. S. A. Ponniah, Chief Clerk, assisted by his staff.

The district offices of the Department, however, suffered particularly heavy losses. A large proportion of note-books, records and maps could not be traced. The loss of one memoir with geological map ready for publication, and other valuable records will necessitate the re-mapping of large areas under survey before the war.

STAFF.

3. Mr. E. S. Willbourn, Director, Geological Survey Department, Federated Malay States, was granted leave prior to retirement on 20th October, 1945, after having been a member of the Department for over 31 years and in charge of it for 15 years.

His numerous publications will always serve as a reminder of his eminent services to Malaya. During his period of office the detailed geology of selected areas was given prime importance and three memoirs covering about 1,200 square miles were published. Had not war intervened much greater benefits from his work would have resulted. Dr. F. T. Ingham, Mining Geologist, returned from leave on 20th June, acted as Director from 23rd June and was appointed Director with effect from 1st April, 1946, inclusive.

Mr. H. E. F. Savage, Geologist, Nyasaland was re-appointed to the Malayan Establishment and arrived on 12th February, 1946. During the period 1st April, 1946, to 22nd June, 1946, he acted as Director.

Mr. H. Service returned from leave on 5th November, 1946, and shortly afterwards recommenced work in Kuala Lipis.

Lt.-Col. F. W. Roe was not released from army duties until 18th November and he proceeded on leave on 27th November, 1946.

Mr. J. B. Alexander returned from leave on 20th June, 1946, and resumed field-duties at Bentong.

Mr. F. H. Fitch returned from leave on 13th September, 1946, and was stationed at Kuantan.

Captain W. D. Bell, was seconded to the Geological Survey Department during the period from October, 1945, until he proceeded on leave in June, 1946.

Messrs. W. A. Tooke and G. M. Harral, Chemists, returned from leave on 11th May and 16th June, respectively; and Mr. W. A. Tooke proceeded on leave on 19th November, 1946.

Dr. J. A. Richardson resigned from the service on 13th July, 1946.

The deaths are recorded, with deep regret, of Che Yeop bin Uda Rasit, Che Alang Ishak bin Alang Saad, Rock-collectors, and Mr. Lee Koo Pong, Laboratory Assistant, during the occupation period.

FUNCTIONS OF THE GEOLOGICAL SURVEY.

4. The main function of the Geological Survey is the promotion of the economic development of the mineral resources of Malaya. The first step towards this is the preparation of a general geological map of the country, as such provides the best means of contributing towards an understanding of the distribution and origin of the mineral deposits. A general reconnaissance survey has been made and a map published; this however contains many blanks and portions show colours based on surmises from the geology of adjacent country. Detailed geological mapping on the scale of 1 inch to 1 mile of known mineral fields and of selected areas previously covered by the reconnaissance survey is being carried out. As the greater part of the country is under jungle, geological work of this nature is perforce a slow and arduous undertaking. The progress chart indicates those areas where surveys have been completed and those under survey.

5. Regional maps of four of the States showing zones of (a) mining land, (b) potential mining land, (c) possible new mineral producing areas and (d) areas not likely to be required for mining, have been prepared for use of other government departments. As the area covered by detailed geological surveys increases and more prospecting by government and private companies is carried out, so will these regional maps become more accurate. The ultimate aim is to produce maps showing only land required for mining and that available for other purposes.

Other duties of the department include the furnishing of reports to other government departments and to the general public. Chemical work is mentioned in paragraph 177.

REVENUE.

6. The revenue collected from 1st April-31st December, 1946, was as follows:

Assays for miners	...	...	\$272	as against	\$2,208	in 1940
Fees for reports and microscopical examination	...	...	43	..	227	..
Sale of publications	...	...	103	..	311	..
Sale of distilled water	...	...	—	..	2	..
Miscellaneous receipts	...	...	206	..	25	..
			<u>\$624</u>		<u>\$2,773</u>	

The Chemical Laboratory did not commence to function until May and normal work was not carried out owing to lack of necessary chemicals and apparatus.

EXPENDITURE.

7. The actual and estimated expenditure during the latter nine months of 1946 were respectively as follows:

	Actual.	Estimated.
Personal Emoluments	\$37,306	\$56,325
Clerical Service	5,210	7,830
Other Charges, Annually Recurrent	10,482	21,070
Other Charges, Special Expenditure	20,709	48,300
	<u>\$73,707</u>	<u>\$133,525</u>

The actual expenditure was much lower than was anticipated owing to the non-arrival of essential equipment ordered from England and late return of Senior staff.

REPORTS.

8. Reports were furnished on geological aspects of certain engineering problems for the Public Works and the Electrical Departments.

Reports on ore deposits or on the geological structure of mining propositions in the Malayan Union can be furnished on payment of a fee of sixty dollars for each day's field-work and expenses charged in accordance with the Government's General Orders.

ASSAY FEES.

9. The Chemical Laboratory, besides carrying out free analyses for other government departments, receives for assaying samples from the public, for which the following charges are made:

- (a) If the sample originates from the Malayan Union and a signed statement certifying the origin is supplied:

The determination of one of the following constituents: tin, tungstic acid, gold, silver, lead, per sample \$10

In more than two samples, up to four, sent together, per sample 8

Beyond the first four samples, up to a total of ten, per sample 6

Beyond the first ten samples, per sample 3

- (b) If the sample originates from outside the Malayan Union the charges will be double the amounts given above.

PUBLICATIONS.

10. A paper entitled "The Coal veins of British Malaya" by J. A. Richardson, was published in the Geological Magazine, Vol. LXXVIII, No. 6, November-December, 1941, pages 451-462. Dr. J. A. Richardson also published a paper "The Stratigraphy and Structure of the Arenaceous Formation of the Main Range Foothills, F.M.S." in the Geological Magazine, Vol. LXXXIII, No. 5, September-October, 1946, pages 217-229. Mention must also be made of a paper by J. B. Scrivenor, late Director, Geological Survey Department, Federated Malay States, entitled "Geological Research in the Malay Peninsula and Archipelago" published in the Geological Magazine, Vol. LXXVIII, No. 2, March-April, 1941, pages 125-150.

LECTURE.

11. Mr. E. S. Willbourn gave a lecture entitled "The relationship of the Geological Survey to the Mining Industry of Malaya" in March, 1946, at the Imperial Institute, South Kensington. This was published in the Bulletin of the Imperial Institute, Vol. XLIV, No. 2, pages 128-148.

ENQUIRIES AND IDENTIFICATIONS.

12. Enquiries were answered about water supply and road metal, and about metalliferous ores and economic minerals including bauxite, gypsum, ilmenite, iron-ore, manganese, monazite and zircon, as well as moulding sands and materials for manufacture of cement.

Several minerals and rocks were received for identification, a service provided free of charge if the specimen is from the Malayan Union and if its exact locality is disclosed.

13. Numerous Banka Drill bore-samples were examined for determining if bedrock had been reached or if there remained the possibility of the occurrence of tin-bearing alluvium at depths below those reached by the bores. Others were examined to decide the type of foundation necessary for buildings containing heavy vibrating machinery. A number of mineral analyses of concentrates were made to determine the minerals present and their approximate proportions.

RECORDS OF PROSPECTING RESULTS.

14. Fortunately the central collection of records of prospecting files at the head office did not suffer as great a loss as was anticipated, and only 41 files were missing. During the year 18 records were added. The collection now contains 1,819 records of prospecting in Perak, 578 in Selangor, 195 in Negri Sembilan and 280 in Pahang.

15. Several firms who have lost their prospecting plans have taken the opportunity of having copies made from those in the central collection at a nominal fee. Miners interested in any area should consult this central collection to see if it contains information useful to them. Prospecting results in State land cannot be disclosed until three months after the prospecting licence permit has expired. Prospecting results in land reserved for any public purpose cannot be disclosed within a period of three months unless the consent of the officer in charge of the reserve and also of the prospector has been obtained. In the case of alienated land, results cannot be disclosed within a period of three months after the termination of prospecting operations unless the consent of both the owner and the prospector has been obtained; when the three months period after prospecting has expired, it will be necessary to have the consent of the owner only.

16. In addition to making information concerning our mineral deposits easily accessible to Government and to the public, the collection helps to ensure that the maximum possible use is made of all the prospecting done in Malaya and that money is not wasted by any unnecessary repetition. The possessors of results obtained by prospecting in any of the former Unfederated States, and in the Federated States prior to 1924 or during 1941 are invited to loan them to the Geological Survey Department, and this request includes the prospecting done by mining companies on land already alienated for mining. In this latter case, the information is required in order to correlate the relationship between the occurrence of mineral deposits and geological conditions, for instance, the nature of bedrock.

GEOLOGICAL COLLECTIONS FOR SCHOOLS AND OTHER INSTITUTIONS.

17. A collection of specimens of Malayan rocks and minerals was made for Raffles College. Additional specimens have been collected to provide further sets of rocks and minerals for educational purposes.

ACKNOWLEDGMENTS.

18. Officers of the Mines Department are thanked for reporting items of geological interest in mines. This assistance is particularly appreciated as only a small area of Malaya is under detailed examination by the geologists and it is thus not possible that all mines showing important geological interest can be visited by them without such reports being received. Many of the production figures in this report have been furnished by the Mines Department.

Specimens for the museum were provided by Mr. J. C. S. O'Hara who also furnished information regarding mining operations by the Japanese during their occupation in Kedah. Detailed analyses of ilmenite from Malaya were furnished by Mr. R. S. Hunter. Thanks are also due to the Mineral Resources Department of the Imperial Institute for examining specimens submitted to them. One of these reports is given in paragraphs 43 and 44.

ALUMINIUM ORE (BAUXITE).

19. Bauxite, the ore of aluminium, is probably of widespread occurrence in Malaya but up to the present deposits have only been worked in Johore and Malacca, although the mineral is known to occur also in Pahang and Selangor, and has been reported from Kedah. Bauxite is essentially formed near ground level by the weathering of parent rocks in such a manner that the combined silica, lime, magnesia and alkalis have been removed by solution leaving a residue rich in hydrated oxides of aluminium and iron. Some of the commercial deposits have resulted from the weathering of ancient volcanic rocks but others are known to have been derived from shale.

20. Production of bauxite, which was worked solely by Japanese companies, commenced in 1936 and three mines in Johore have produced this mineral. The figures of bauxite in long tons exported prior to the war are as follows:

	1936.	1937.	1938.	1939.	1940.	1941. (10 months)
Bukit Pasir Mine, Batu Pahat ..	36 ..	13,000 ..	37,137 ..	33,763 ..	29,654 ..	24,687
Sri Medan Mine, Batu Pahat ..	— ..	— ..	3,619 ..	37,828 ..	28,729 ..	26,138
Perigi Achih Mine, Kim Kim ..	— ..	90 ..	14,995 ..	12,796 ..	— ..	—
Totals ..	36 ..	13,090 ..	55,751 ..	84,387 ..	58,383 ..	50,825

Bulk assay figures for 1940 were 57-60 per cent. Al_2O_3 at the Bukit Pasir Mine, and between 55 and 58 per cent. Al_2O_3 at the Sri Medan Mine.

21. Brief descriptions of these bauxite deposits have been published in the Annual Reports of the Geological Survey Department as follows: 1936, paragraphs 54-59; 1937, paragraphs 38-43; 1938, paragraphs 36-44.

The following information regarding bauxite developments during the Japanese war was obtained by Capt. Bell, Geologist, from interviews with former Japanese officials.

22. *Bukit Pasir Mine, Batu Pahat.*—Re-equipment started in 1942 and mining was recommenced in May of that year. Frequent shipments of ore were made up to December, 1944, approximately 150,000 tons being exported to Japan. No transport steamers were available after that date and operations ceased in March, 1945, when all payable ore had been mined leaving a stock of about 30,000 tons stacked on the mine.

23. *Malacca Bauxite Mine (Telok Mas).*—This mine is situated at Bukit Seberang about 7 miles from Malacca on the Muar road. Prospecting of the area, in which the bauxite appears to have been formed by the weathering of diorite, had been carried out in 1939. The Japanese Military Administration ordered work to commence there in 1942. Most of the equipment was brought from the Sri Medan Mine, but some was obtained from Japan. Production commenced in August, 1943, and up to October, 1944, approximately 100,000 tons of ore was shipped to Japan. Lack of transport prevented further shipments. The ore was stated to assay 52 per cent. Al_2O_3 , 4 per cent. SiO_2 , 1 per cent. TiO_2 , and 10 per cent. Fe_2O_3 . It was estimated in March, 1945, that approximately 200,000 tons of unmined ore remained and that approximately 70,000 tons of produced ore were present in stock piles on the property.

24. *Nangan Bauxite Mine.*—This is situated near Bukit Simon about 10 miles east of Kampong Pengarang, S.E. Johore, and the bauxite deposits cover a large area in this neighbourhood. Bauxite was known to occur here since 1935 but mining licences had been refused. The Japanese estimated that the area contained about ten million tons of ore and commenced development in May, 1942, with a view of producing 500,000 tons annually. Equipment was brought from the Kemaman Iron Mine, Trengganu, but non-arrival of additional machinery from Japan caused the plan to be discontinued.

Only one consignment of 3,450 tons was shipped to Japan in July, 1944, and approximately 42,000 tons of mined ore remained on the property. The average grade of ore of the deposit was stated to be Al_2O_3 56 per cent., SiO_2 4 per cent., TiO_2 0.7-0.8 per cent. and Fe_2O_3 6.7 per cent.

CHINA CLAY.

25. China Clay (Kaolin) is of widespread occurrence in Malaya. Production is however only on a small scale and the bulk is used as a filler in local manufacture of rubber goods. During recent years two mines, one near Tapah, Perak, and the other in Selangor, near Pudu Ulu, have been worked.

Production figures are as follows:

1937.	1938.	1939.	1940.	1941.	1946.
Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
263	385	493	408	*930	246

* This figure is for first 10 months of year and of this amount 306 tons were exported.

COLUMBITE-TANTALITE.

26. In the Report of the Geological Survey Department for 1937, paragraphs 44-49, information was given concerning columbite-tantalite ores. These form an isomorphous series of mixed niobates and tantalates of iron and manganese (Fe , Mn) $(\text{Nb}$, $\text{Ta})_2\text{O}_6$ varying from nearly pure niobate (columbite) to nearly pure tantalate (tantalite). Columbite was known to occur associated with tin ore near Bukit Dinding one mile west of Bakri and about $8\frac{1}{2}$ miles east of Muar, Johore, for many years. The Japanese Military Administration ordered an investigation of the area to be made and, after boring had been carried out over about 500 acres, a mine was opened on the Lee Rubber Company's Estate. It was estimated that the area prospected

could produce about 50 tons of columbite, having a composition of 12 per cent. Ta_2O_5 and 25 per cent. Nb_2O_5 , the mineral having been derived from pegmatite. Magnetic separators were used and during the period September, 1944, to August, 1945, 3,000 kilograms were produced of which 2,500 kilograms were taken by the Mitsui Bussan Company, the remainder being stored on the mine.

27. Some columbite was also obtained from Kedah near Semiling, south-east of Gunung Jerai. Boring was carried out and it is said that the alluvium here contained cassiterite and columbite in the approximate proportion of 70 per cent. tin-ore to 30 per cent. columbite. A mine was opened on Bukit Mertajam Estate. The mixed ore was transported to the Penang Smelter for magnetic separation, and monthly production of 300 kilograms of columbite is said to have been obtained. It is also reported that columbite was obtained by dulang women from stream gullies on Gunung Jerai. The mineral in this neighbourhood is believed to have been derived from pegmatite veins which are known to occur in this area.

Samples from both Bakri and Semiling have been sent to the Imperial Institute for examination.

GOLD.

28. The principal source of gold in Malaya prior to the war was the Raub Australian Gold Mine in Pahang. Gold is also produced in Perak in the Tapah-Bidor area where the gold is associated with tin-ore. Some gold is also recovered by tin dredges operating in Selangor and this mineral is produced more especially from stream deposits, in Kelantan, Johore and Malacca and Pahang.

29. The following figures in ounces troy show recent gold production:

Year.	Pahang.	Perak.	Selangor.	N. Sembilan.	Kelantan.	Johore.	Malacca.	Total.
1937 ..	26,175	7,043	585	25	516	3	..	34,347
1938 ..	33,680	5,444	508	577	546	34	5	40,794
1939 ..	33,385	5,814	442	542	858	21	3	41,165
1940 ..	28,361	8,374	895	70	479	7	12	36,198
1941 (10 months)	24,743	4,636	617	78	Nil	Nil	Nil	30,074
1946 ..	43	401	..	..	..	..	..	444

GRAPHITE.

30. During the Japanese occupation graphite was produced from two small mines about three-quarters of a mile apart near Bukit Kuang, Chukai, Trengganu. These were examined by Mr. Savage and Capt. Bell. The graphite occurred in strongly dipping graphitic shales which associated with quartzites and shales form the ridge south of Kemaman, known as Bukit Kuang. The following is an extract from Mr. Savage's report.

"At the workings proper, at Bukit Kuang, the tunnels had all collapsed so that it was only possible to examine the rocks near their entrances. The sediments strike 15° east of north and have vertical, or steep westerly dips. A body of graphite of vein-like appearance was seen: it is three to four feet thick, and its strike and dip are conformable with the country rocks. The graphite is abundantly traversed by small veinlets of quartz and is frequently crumpled, but silica-free, solid graphite occurs in fair quantity as "eyes" up to about 6 inches long, which could, if necessary be hand picked from excavated ore. The limited evidence now available gives the impression that the graphite occupies a fault or a shear zone."

31. Officials of the Nippon Kogyo Kabushiki Kaisha in an interview with Capt. Bell stated that mining commenced in November, 1943, and ceased in June, 1945. The graphite was mined by means of adits and during the period work was in progress 650 tons of ore were produced. The ore is stated to have carried between 10 and 20 per cent. of graphite, and from this by washing and hand picking a standard concentrate of 40 per cent. was obtained but the best hand-picked ore ran 60 per cent. graphitic carbon. (A grab sample from a dump near Chukai gave 21.7 per cent. loss on ignition). Three hundred and fifty tons of concentrate was sent to Singapore where it was used in the preparation of castings and electrodes. The deposit was not considered of sufficiently high grade to be worked profitably under peace-time conditions.

ILMENITE.

32. Ilmenite, iron titanate, a compound of iron, titanium and oxygen, is the chief constituent of "amang", the heavy part of the waste material left after the separation of tin-ore from the alluvial mines of North and Central Malaya. Where magnetic separators have been used to dress the ore the "amang" is almost entirely ilmenite. The mineral is of commercial use as the source of titanium white, the chief constituent in titanium paints. A comprehensive list of other uses was given in paragraph 30 of the Annual Report for 1936. Large quantities of this mineral are present in the amang dumps of numerous dredging companies in Malaya.

Exports from Malaya have been as follows:

1937.	1938.	1939.	1940.	1941.	1946.
Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
6,252	6,462	11,098	2,555	44	Nil
(9 months)					

To be saleable the amang should contain not less than 48 per cent. TiO_2 . Samples carrying a greater proportion of ferrous to ferric iron are preferred. Export is not permitted of ore containing 0.5 per cent. or over of SnO_2 .

IRON-ORE.

33. Iron-ore was mined and exported to Japan by Japanese companies during a period of twenty years prior to the war, and a steady increase of exports up to 1941 is shown by the following export figures in long tons:

State.	Mine.	1937.	1938.	1939.	1940.	1941.
						(10 months)
Johore	Sri Medan Mine,					
	Batu Pahat	465,486	549,960	423,093	464,789	218,469
"	Izuka Mine, Endau	..	..	239,772	160,891	146,358
Trengganu	Dungun Mine	1,024,215	905,316	905,850	998,892	680,275
	Machang Stahun,					
	Kemaman					
Kelantan	Temangan Mine	49,223	159,900	208,820	228,252	not available
Total		1,538,924	1,615,176	1,938,587	1,995,149	1,045,102

The iron ore exported was generally of high grade. The iron percentage of ore from Sri Medan averaged between 60 and 64 per cent. iron, from Izuka Mine 55 per cent., Dungun 62 per cent., Machang Stahun 46 to 50 per cent. iron and 5 to 10 per cent. manganese, and Temangan about 56 per cent. iron.

The following information regarding Japanese mining operations during their occupation was obtained by Mr. Savage and Capt. Bell.

34. *Sri Medan Mine*.—The geology of this deposit has been described by E. S. Willbourn in "The Geology and Mining Industries of Johore" in the Journal Vol. VI, Part IV, of the Malayan Branch Royal Asiatic Society and by F. T. Ingham in the Report of the Geological Survey Department for the year 1934, paragraphs 43-47. The mine was badly damaged during the battle of Malaya. The remaining plant was transferred to the Malacca bauxite mine. Out of a stock of approximately 61,000 tons of extracted ore, about 1,000 tons were used in the production of pig iron, the ore being smelted at Johore Bharu with charcoal from mangrove areas.

35. *Dungun Mine, Trengganu*.—This mine from 1942 to end of March, 1944, exported 130,000 tons of iron-ore. At the end of March, 1944, there were about 800,000 tons of clean ore remaining in stockpiles ready for shipment. Owing to shipping difficulties some of the ore was converted into pig-iron of which some 2,700 tons remained in stock at the cessation of hostilities.

36. *Machang Stahun, Kemaman, Iron and Manganese Mine*.—No production of ore was made during the Japanese occupation as the mining company, due partly to financial and political difficulties and partly to the approaching exhaustion of the deposits, ceased operation in 1941. The mine was opened in 1922 and during its lifetime produced approximately one and a half million tons of iron-ore and 200,000 tons of manganese-ore. Some tin-ore occurs in the deposit and between February, 1939, and November, 1941, approximately 270 tons of tin concentrates were recovered from 41,579 tons of tin-bearing ferro-manganese ore. Most of the mining equipment was transferred to the Nangan Bauxite Mine, Johore.

37. *Temangan Mine, Kelantan*.—No details of production have been obtained. The Japanese Military Administration gave instructions that the ore was to be smelted locally and some ore was utilised for this purpose.

38. *Tambun, Perak*.—The hematite deposit occurring in limestone country on Gunung Panjang Estate near Tambun, Kinta, has been mined on a small scale for several years prior to the war solely for use as "ragging" for dredge jigs, the mineral being broken into small pieces for this purpose. The deposit, although high grade carrying about 68 per cent. iron and of apparent large extent, was not worked as iron-ore since its location precluded cheap transport to the sea. Production for this purpose was as follows:

	1937.	1938.	1939.	1940.	1941.	1946.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Used in Malaya	869	557	410	644	822	321
Exported	278	306	359	313		
	<u>1,147</u>	<u>863</u>	<u>769</u>	<u>957</u>	<u>822</u>	<u>321</u>

The Japanese however constructed a railway to connect with the main line and transported ore to Taiping for smelting. Mining commenced in October, 1942, and continued to July, 1945, during which period 41,575 tons of ore were removed.

39. *Rompin*.—Shortly before the war prospecting for iron-ore was being carried out in Ulu Rompin, and the geology of this area is described in paragraphs 173 and 174.

MANGANESE-ORE.

40. All manganese-ore produced in Malaya has been worked by Japanese companies. Production figures are as follows:

	1936.	1937.	1938.	1939.	1940.	1941.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Machang Stahun Mine, Trengganu ..	26,773 ..	23,126 ..	23,054 ..	19,900 ..	—	.. Not available
Tandok Mine, Kelantan ..	10,006 ..	8,796 ..	8,916 ..	11,100 ..	11,825	
	36,779 ..	31,922 ..	31,970 ..	31,000 ..	11,825	

The Machang Stahun-ore is a mixture of low grade hæmatite and low grade manganese and carries from 5-10 per cent. Mn. The Tandok Mine near Gual Priok produces ore containing approximately 37 per cent. manganese. In this locality during the war the Japanese opened a new working at Lubok Iték, north-west of the Garu working. The exports from these mines are stated to have been

1942.	1943.	1944.	1945.
Tons.	Tons.	Tons.	Tons.
Nil	209	651	41

41. No production was made at Machang Stahun during the Japanese occupation. The Japanese Military Administration gave orders that manganese-ores in the neighbourhood of the Sungei Aring, Kelantan, reference to which was made in the Annual Report for 1936, paragraph 53, were to be mined, but lack of transport facilities caused the plan to be abandoned in September, 1943.

MICA.

42. Mica was worked as a by-product in a tin mine known as the Fook Wan Foh Kongsí near Chenderiang, by the Japanese. The mine is situated at the granite-limestone contact and a dyke of pegmatite containing beryl and mica occurs. As the mica, did not appear to be of commercial quality a sample was forwarded to the Imperial Institute for examination and the following report was furnished by Mr. G. E. Howling, Principal of the Mineral Resources Department:

43. "This sample, consisting of five specimens (B.1-B.5) was made up of numerous small plates of a fawn—or biscuit-coloured mica obtained from the pegmatite and associated veins mentioned above. As the material, judged by ordinary standards was of very poor quality, but had nevertheless been exported to Japan by the Japanese, the question arose as to whether the mica possessed any unusual or special property. To determine

the precise nature of this mica, specially picked flakes from the cleanest parts of fraction B.2 were, therefore, analysed in detail, with the following result:

Analysis of Selected Mica Flakes from Sample B.2.

		Per cent.
Silica	SiO ₂	42.56
Alumina	Al ₂ O ₃	23.00
Ferric oxide	Fe ₂ O ₃	0.66
Ferrous oxide	FeO	11.26
Magnesia	MgO	0.16
Lime	CaO	0.08
Soda	Na ₂ O	0.83
Potash	K ₂ O	9.34
Water, up to 105°C.		0.45
Water, 105° to 300°C.		0.30
Water, over 300°C.		1.49
Titanium dioxide	TiO ₂	0.44
Fluorine	F ₂	5.70
Manganous oxide	MnO	2.51
Lithia	Li ₂ O	3.00
Rubidia	Rb ₂ O	0.24*
Cæsia	Cs ₂ O	0.17*
Phosphoric anhydride	P ₂ O ₅	trace
Vanadium pentoxide	V ₂ O ₅	not detected
Chromic oxide	Cr ₂ O ₃	not detected
		102.19
Less O=F		2.40
Total		99.79

Analyst: W. H. Bennett, M.Sc., F.R.I.C., Imperial Institute.

From the above analysis it will be seen that on calculating the molecular proportions and plotting R₂O₃ against RO, in accordance with Hallimond's "Chemical Classification of the Mica Group" (see Mineralogical Mag. 1925, 20, 109), the mineral under investigation falls near to zinnwaldite. The lithia content of 3 per cent. is noteworthy and places the mica, from a chemical point of view, in the lithiamica group; indeed, the term lithia-mica is perhaps a good description of this material."

44. *Possible industrial uses.*—In view of the lithia content of this mica, and the fact that Japan does not possess any considerable resources of lithium minerals, it is possible that the Japanese were interested in this material as a source of lithium or lithium salts. This would be analogous to German practice, as for many years the Metallgesellschaft of Frankfurt-am-Main, drew the bulk of their supplies of lithium raw materials from the lithia mica deposit of the Zinnwald district, the mica containing from 2½ to 3 per cent. Li₂O.

On the other hand, the Japanese, faced with an acute shortage of good mica, might have utilised this material (which under normal circumstances would not be an economic proposition) for the production of very small "splittings" which could be used in the manufacture of micanite. The Germans did a similar thing during the war, utilizing low-grade mica from European sources, as was reported some time ago by Dr. E. R. Varley of this Department who investigated the German war-time mica situation. The present sample, however, represents a quality even worse than that which the Germans were using, though

* These results should be regarded as approximations, owing to the deficiencies of chemical methods for the determination of small quantities of these elements.

for many purposes, micanite, even if considerably of sub-standard quality, is better than many of the alternatives and substitutes for mica.

Judging from the sequence of specimens B.1 to B.5 it is possible that the material was intended for the production of mica powder. A small sample of such powder was made at the Institute from specimen B.5, but the product is not of high quality, although it could doubtless be used under war conditions. As may be seen from the samples enclosed with this report, the colour of the mica is improved by acid treatment. During the war the Japanese are known to have used a bonded mica-dust as a substitute for mica. Finally, there is the possibility that the potash content (9.34 per cent.) of this mica might have interested the Japanese from the point of view of applying powdered mica as a soil-dressing."

TIN-ORE.

45. Malaya normally produces more tin than any other country. The metal is obtained from the mineral cassiterite SnO_2 , commonly known as tin-ore. Most mines operate in alluvial beds of clay and sand containing waterworn grains of cassiterite but in pre-war years some of the production was obtained from lode mines. These comprise workings of stanniferous veins and pipes in both granite and sedimentary rocks. Detailed figures of production are given in the bulletins of "Statistics relating to the Mining Industry" compiled in the office of the Chief Inspector of Mines, Malayan Union.

TUNGSTEN-ORE.

46. Wolfram, tungstate of iron and manganese, and scheelite, calcium tungstate, are both produced in Malaya. Since the closing down in 1939 of Kramat Pulai Scheelite mine, world-famous producer of this ore, export of scheelite has become relatively unimportant.

The chief localities where wolfram is mined are Kedah (Bukit Kachi mine) and Trengganu (Chendrong Wolfram mine) but small quantities are obtained from mines producing tin-ore in Perak, Negri Sembilan, Selangor and Pahang.

47. Exports of Wolfram. Federated Malay States and Unfederated Malay States:

	1937.	1938.	1939.	1940.	1941.
	Tons.	Tons.	Tons.	Tons.	Tons.
Federated Malay States ...	27	20	25	38	49 (9 months)
Unfederated States ...	213	353	409	371	274
	240	373	434	409	323 (approx.)

During the Japanese occupation 33 tons of wolfram were produced in 1943 and 55 tons in 1944 from Trengganu, the output being from the Chendrong Wolfram mine and a mine near Sungei Buloh Lipis. In Kedah wolfram obtained from the Bukit Kachi mine near Sintok was approximately 20 tons during 1943 and about 36 tons in 1944.

EXPORTS OF SCHEELITE.

1937.	1938.	1939.	1940.	1941.
Tons.	Tons.	Tons.	Tons.	Tons.
836 ...	281 ...	217 ...	427 ...	40

Most of the ore came from the Kramat Pulai mine.

PROGRESS REPORT ON GEOLOGICAL WORK IN SOUTH
SELANGOR BY DR. F. T. INGHAM, DIRECTOR.

GENERAL.

48. Except for sporadic visits, the Kuala Lumpur tinfield with its adjoining areas has not been examined since a knowledge of its general structure was determined by the late Director, Mr. E. S. Willbourn, who carried out field work from July, 1914, to June, 1917, and from May to November, 1920. The results of his investigations were published in 1922 in his memoir "An account of the Geology and Mining Industries of South Selangor and Negri Sembilan" with which a geological sketch map was included. A brief description of the more important mining localities is given in "The Geology of Malayan Ore-deposits" published by Mr. J. B. Scrivenor in 1928.

49. The area, over which a detailed geological survey was commenced by the writer in 1940 and which is being continued by Mr. H. E. F. Savage, Geologist, comprises that part of Selangor which lies between lines of latitude $2^{\circ} 45'$ and $3^{\circ} 15'$; on the west are the Straits of Malacca, and on the east the area adjoins the Negri Sembilan State boundary. It has a superficial extent of approximately 1,350 square miles, and is shown on Topographical Sheets 3 B 14, 3 B/15, 3 F/2, 3 F/3 and also on part of sheets 3 B/16 and 3 F/4. Work has been concentrated on sheet 3 B/15, but portions of the other sheets have also been traversed.

ROCK FORMATIONS.

50. *Limestone and Associated Rocks.*—Limestone and associated rocks believed to belong either to the Carboniferous or to the Permocarboniferous system, constitute the oldest rocks in the area. Unfortunately fossils that give decisive information about age have not yet been found. The rocks comprise limestone, calcareous shale, schist and phyllite, and have been described by Mr. Willbourn in the above-mentioned memoir as the Raub Series. They are now known as the calcareous formation.

51. *Limestone.*—There are four main areas in which limestone is well developed.

Limestone forms the conspicuous hill known as Batu Caves and constitutes the bedrock over the major portion of the flat country to the north-northwest, north, east and south of Kuala Lumpur. This plain, roughly rectangular in shape, extends from near Kepong and Batu Caves to near Ampang, Pudu Ulu and Salak South.

The strip of lowlying ground extending in a southerly direction from a point about half a mile southeast of Salak Hill to approximately a mile south-southwest of Serdang also shows limestone beneath the alluvium.

Boring operations have proved that limestone extends from Sungei Way along the flat ground of the Sungei Klang valley to the south, to a point within a mile northwest of Bukit Jerampang.

A smaller patch of limestone country, over two miles wide, separated from that near Sungei Way by a narrow strip of phyllite and quartzite, is situated to the west and southwest of Petaling village.

In addition to the above, limestone has been proved by boring to occur beneath swampy ground near the Sungei Buloh about a mile southwest of Kampong Sungei Plong.

52. *Schist, phyllite and shale.*—Undulating country, south and southeast of Serdang, forms a continuation of the limestone plain to the north. It is composed of schist, phyllite and shale. Owing to the absence of sandy beds these were mapped by Mr. Willbourn as the Raub Series, and were thought to be more or less contemporaneous with the limestone and associated rocks near Kuala Lumpur. The reported presence of limestone associated with phyllite in a disused mine near Kajang, and limestone fragments obtained in 1940 from bores about 1½ mile east of Reko Hill seem now to confirm that these rocks belong to the Calcareous Formation. This development of schist, phyllite and shale extends from near Serdang in a southeasterly direction. These same rocks have been proved to occur along the valley of the Sungei Langat, south of Kajang and in a belt between the granite of the Main Range and the quartzite country to the west.

Besides these large outcrops, lenticles of shale occur, in the limestone of the Kuala Lumpur plain, apparently interbedded with it. The largest of these, weathered on the surface to 'laterite', forms slightly higher ground between Batu and Kepong and extends about 1½ miles from near Kampong Jinjang to Kampong Bangkong. Smaller lenticles have been proved by boring to be present both south of Batu and in the eastern part of Batu Caves Estate.

53. *Quartzite and associated rocks.*—Quartzite, schist, phyllite and shale, believed to belong to the Triassic system, are well developed to the west of Kuala Lumpur. They form hilly country extending southwards from Segambut through Petaling, Ayer Itam Forest Reserve, and Bukit Tunggul towards Sepang. Many of the exposures show quartzite bands interbedded with shale, but schist and phyllite also occur throughout the area.

54. Similar rocks are present west of the Bukit Lagong—Bukit Lanchong granite, and quartzite is developed west of the Sungei Buloh Forest Reserve and also further south in the Bukit Cheraka Forest Reserve. Lower country to the east flanking the granite may belong to the same series, but phyllite and shale predominate, and it is possible that at least part of the lowlying ground along the Sungei Klang, south of Batu Tiga and also the area west of Sungei Buloh may belong to the calcareous formation, especially as limestone is known to occur southwest of Kampong Sungei Plong and has been reported from one bore two miles northwest of Bukit Lanchong.

55. Schist and shales, forming an interrupted fringe around the Kuala Lumpur alluvial plain, are present near Kepong, in an area extending from near Batu Caves to Gonggang Estate southeast of Setapak, and also to the east and southeast of Ampang. Although quartz-schist occurs among these sedimentary rocks, it is thought that they more probably belong to the calcareous formation than to the Triassic system. Evidence in support of this view is the fact that these rocks, like the limestone near Kuala Lumpur, in general show a dip away from the granite in contact with them. This suggests that in all

three localities the schists dip beneath the limestone and this relationship was confirmed recently in a mine, at the junction of limestone and schist a mile south-southeast of Ampang. Moreover the calcareous nature of some of the schist is indicated by the occurrence of amphibole schist and actinolite-biotite schist southwest of Ulu Klang.

56. Overlying the granite of the Main Range there is a roof pendant of schist, probably two miles wide, near Bukit Arang, east of Ulu Langat. Preliminary field work indicates that other outcrops occur near the Sungei Lui. One of these has been traced to within half a mile of Ginting Peras on the Selangor-Negri Sembilan boundary. Graphitic mica schist is common and some chert has been found in this neighbourhood.

57. *Granite and allied rocks.*—The sedimentary rocks of the sheets under survey have been invaded by granite and it is to these granitic intrusions that the mineralisation of the area can be assigned. The Main Range granite extends from the Selangor-Negri Sembilan boundary over the greater part of sheet 3 B/16 into part of sheet 3 B/15 forming a roughly semi-circular line of contact with sedimentary rocks continuing from northwest of Gombak, through Ulu Klang, east of Ampang, and near Pudu Ulu and Salak South. Where the granite is in contact with limestone from the north of Ampang to the west of Salak South, a distance of about five miles, the line of their junction is very irregular being approximately twelve miles. From south of Salak South the contact passes through the largest mines of Sungei Besi to near Serdang, turning eastwards towards Kajang. Thence, on sheet 3 F/4, it follows a roughly south-southeasterly direction to the Negri Sembilan boundary.

58. A secondary granite range forming a spur from the Main Range extends from Bukit Lagong, north-northwest of Kepong, southwards through Bukit Lanjam, Sungei Way, and Bukit Lanchong. It has been proved by boring to stretch into the northern part of the Kuala Langat (North) Forest Reserve. The eastern boundary of this granite follows a line from near Kampong Pinang Baik to the west of Kepong, whence it turns southeasterly towards Segambut. It then proceeds southwards through Segambut Estate, Bukit Kiara Estate and Palmland Estate. From Sungei Way it follows the western side of the Sungei Klang valley to Kampong Pulas. The boundary on the west has not yet been delineated with the same accuracy, but the contact is known to occur generally to the east of the railway between Kuang and Sungei Buloh. Granite is known from bores to be present in the Sungei Buloh Forest Reserve along the swampy area near the Sungei Kenondong and this may form a tongue joining the granite of the higher ground to the east. Granite close to the contact is also shown in a stream bed about two miles south-southwest of Bukit Nibong Gila and the junction passes close to Batu Tiga proceeding south-southeast, crossing the Kuang-Puchong road near the 16th mile post, then south-southwestwards towards Kampong Bukit Kamuning.

59. Granite also forms the isolated hill of Jugra.

Besides the above granite masses, smaller granitic intrusions occur in the sedimentary rocks, more particularly in the limestone country near Kuala Lumpur. Some of these have been uncovered during mining operations, others have been revealed by boring.

The largest, about one mile across, is near Setapak. Others are situated north of Batu and between Pudu Ulu and Salak South.

60. The granite of the area under survey is similar to that in other parts of Malaya. A medium to coarse grained porphyritic granite is common, often with two micas present. Fine grained microgranite, and granite-porphyry also occur, and veins of both aplite and pegmatite are known.

61. Besides the large quartz vein, described by Mr. Willbourn, forming very conspicuous cliffs between Ulu Klang and the Sungei Batu valley, there are other well defined veins forming less pronounced features both northeast of Serdang and east of Ulu Langat. Other outcrops of quartz occur near Reko Hill and large crystals of quartz strew the ground in Braemar Estate, near Kajang.

ECONOMIC GEOLOGY.

TIN.

62. Tin-ore has been won for many years in this area, the bulk of the ore being obtained from stanniferous alluvium. The chief producing mines are in the Kuala Lumpur basin, Sungei Besi, Serdang, Petaling-Sungei Way and the Sungei Klang valley. Other localities where mining was in progress immediately prior to the Japanese occupation include Kajang, the valley of the Sungei Semenyih and its tributaries the Sungei Lalang and Sungei Kachau, and Bukit Arang.

63. The source of the alluvial tin-ore is undoubtedly stanniferous veins and stringers in the granite and sedimentary rocks in contact with it. Tin-ore in situ was being worked in 1940 in sedimentary rocks near the Sungei Kuyoh, and formerly there were similar workings at Pantai and near the 8th mile, Kuchai Road. Greisen veins carrying cassiterite are present in granite near Kepong, providing a portion of the ore obtained in this locality.

64. There were twenty dredging companies and over a hundred gravel pump mines operating in the area during 1940. The deepest open cast mine of Malaya, Hong Fatt mine, is situated between Sungei Besi and Serdang.

65. That the area under survey is important is shown by the following table of production. Approximately one-quarter of the total Federated Malay States production is obtained from it. The figures of tin-ore have been compiled from the Statistics relating to the Mining Industry together with information supplied by the Inspector under the Mineral Ores Enactment.

Year.	Production.	Percentages of F.M.S. production.	Year.	Production.	Percentages of F.M.S. production.
	Pikuls.			Pikuls.	
1928	271,332	18.9%	1936	386,631	26.9%
1929	340,888	21.8%	1937	454,121	27.2%
1930	317,049	21.9%	1938	226,190	24.7%
1931	262,458	21.4%	1939	303,528	25.6%
1932	143,825	18.4%	1940	464,527	25.9%
1933	123,287	18.4%	1941	Not available	
1934	189,160	23.5%	1946	47,276	25.1%
1935	225,706	24.9%			

GOLD.

66. A small amount of alluvial gold has been recovered of late years as a by-product of tin mining by some of the dredging companies operating in this area.

67. Figures of production, in ounces troy, from South Selangor.

	1933.	1934.	1935.	1936.	1937.	1938.	1939.	1940.
Petaling Tin Ltd. ..	—	99.32	250.30	333.46	343.09	227.04	168.75	471.59
Sungei Way Dredging Ltd.	—	1.26	84.57	154.80	138.95	122.70	118.45	170.49
Kent (F.M.S.) Tin Dredging Ltd. ..	—	—	—	39.30	94.46	58.80	34.54	54.16
Selayang Tin Dredging Ltd. ..	2.82	6.88	—	13.75	8.02	1.06	4.51	3.61
Kuchai Tin Ltd. ..	—	—	—	—	—	17.05	28.45	43.96
Stone Tin (F.M.S.) Ltd. ..	—	—	—	—	—	5.48	28.39	69.36
Ampat Tin Dredging Ltd.	—	—	—	—	—	61.23	57.32	66.17
Ulu Klang Tin Ltd. ..	—	—	—	—	—	—	—	6.82
	2.82	107.46	334.87	541.30	584.55	495.11	440.41	802.16

During the first ten months of 1941 the gold production was 617 ounces but recovery of gold from tin concentrates had not recommenced in 1946.

WOLFRAM.

68. In the past, wolfram veins in granite have been worked near Ampang and Pudu Ulu. In recent years the only production has been from veins carrying cassiterite at Bukit Arang and as a by-product from tin mining by the Ulu Klang Tin Ltd. The total production in pikuls during recent years is as follows:

1937.	1938.	1939.	1940.	1941.
				(10 months)
49.08	48.24	69.75	130.93	185

KAOLIN (China Clay).

69. China clay is produced for use as a filler in local rubber manufacture from two workings in weathered granite, near the 3½ mile, Cheras road.

Figures of production are as follows:

1937.	1938.	1939.	1940.	1941.	1946.
Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
				(10 months)	Oct.-Dec.
87	220	314	249	763	156

WHITE ARSENIC.

70. This is obtained by those companies which owing to the presence of arsenopyrite have to roast their tin concentrates. Stocks held at the end of 1939 were over 70 tons and during 1940 local sales to Rubber Estates were approximately 8½ tons.

REPORT BY H. E. F. SAVAGE, GEOLOGIST.

71. After arrival in February the early part of the year was spent mainly at headquarters where until 22nd June the duties of Director were carried out.

In April a visit to Trengganu was made on behalf of the Custodian of Enemy Property and the graphite mine at Chukai and the Machang Stahun mine were inspected. Notes on these properties are included in paragraphs 30 and 36 of this report. In May accompanied by Captain Bell, Johore and Malacca were visited; the columbite mine at Bakri and the bauxite mines near Malacca and in the Bukit Pengarang area, Johore being examined.

72. The duties of Geologist, Selangor South, were taken over from Captain W. D. Bell, on the 29th of June. A good deal of time was occupied in copying recently recovered maps, discussions with the Director, Geological Survey, and Secretariat officers, and miscellaneous duties connected with the re-establishment of the Selangor office and the resumption of the pre-war programme of work. After a series of preliminary visits to all the working mines in the area, actual field work was begun towards the end of July in the region between Ampang and Klang Gates which forms the north-west corner of Topo. Sheet 3 B/16. Work here proved to be rather more arduous than usual, on account of the broken nature of the country and the heavy growth of thick scrub which effectively concealed rock exposures and made travelling difficult and slow. The examination of the area covered by Topo. Sheet 3 B/15 was commenced towards the end of November, beginning in the north-east corner in the vicinity of Gombak.

Special duties undertaken include examination and report upon the site of the new Kuala Lumpur water-supply project at Ulu Gombak and the site of the new electric power-station near Klang where boring and other operations have been put in hand to determine the nature of the bedrock and to test its load-bearing capacity. At the end of October the Selangor office of the Geological Survey Department was transferred from the Secretariat building to more suitable accommodation in the new temporary Government Offices in Batu Road.

GEOLOGICAL SURVEY OF SOUTH SELANGOR.

73. The following paragraphs based on recent field work are an addendum to Dr. F. T. Ingham's report on this area (paragraphs 48-70).

74. What appears at first sight to be an ordinary vein of quartz is seen in the Sungai Klang, at 5½ miles on the Batu Ampat-Ulu Klang road. Close examination, however, reveals that the rock is somewhat different from normal vein-quartz in that it seems to be a chaledonic variety of silica. On one side a clear contact with granite is shown but the other side is obscured by alluvium. If further evidence is obtained to prove that the outcrop is actually a vein then it must be inferred that the vein fills a fissure along which heated waters have passed, because this and allied varieties of silica are generally accepted as being of hydrothermal origin. On the other hand there is the possibility that the rock is an altered chert and that the outcrop represents a contact between granite and sediments. The outcrop forms a more or less vertical bar across the river about 25 feet in thickness.

75. *Quartz-Porphry*.—In the vicinity of Ulu Klang there are several places where quartz-porphry is known to occur. Hitherto the occurrences have been mapped as two separate areas north-west and south-southwest of the Ulu Klang village respectively. The present work, which has been done in much more detail than that carried out earlier, suggests that the quartz-porphry is much more widespread than was thought formerly and that there is but one large area of quartz-porphry extending from about two miles south-southwest of Ulu Klang northwards for some four miles to near Klang Gates and north-eastwards from Ulu Klang for about two and a half miles. Generally speaking, it is bounded on the east and north by granite and on the west and south by schists and shales, but it is not always easy to decide in the field exactly where the boundary between schist and quartz-porphry should be drawn. The quartz-porphry is usually strongly sheared. When decomposed it is distinguishable from certain associated sheared sediments only in thin section under the microscope.

The rock is similar in nature and in mode of occurrence to the quartz-porphry found in the Sungei Siput area, Perak.

PROGRESS REPORT ON GEOLOGICAL WORK IN SELANGOR BY F. W. ROE, GEOLOGIST.

76. The greater part of 1940 and 1941 was spent in Selangor making a detailed geological survey of the area covered by sheets 3 B/10, 3 B/11 and 3 B/12. Work was interrupted by embodiment periods for military training with the Federated Malay States Volunteer Force. Detailed mapping has been carried out over one hundred and fifty square miles of country covered by sheet 3 B/11 and preliminary traverses made over the remainder and over part of sheet 3 B/12. Thirty-one square miles in the south-east portion of sheet 3 B/10 have been mapped and a detailed survey of the Batu Arang coalfield commenced.

THE GEOLOGICAL SURVEY OF THAT PART OF ULU SELANGOR REPRESENTED ON SHEETS 3 B/7 AND 3 B/8.

77. The detailed mapping of the area covered by sheet 3 B/7 and part of 3 B/8 which lies in Ulu Selangor was completed in 1939 and the maps were prepared for publication but unfortunately these, together with the memoir on the geology of this area, together with all field notes were lost during the Japanese occupation. The geology and mineral resources were described in paragraphs 164 to 190 of the Report of the Federated Malay States Geological Survey Department for the year 1937, in paragraphs 112 to 133 of the Report for 1938 and in paragraphs 43 to 83 of the Report for 1939.

THE METAMORPHOSED SEDIMENTARY ROCKS.

78. *The Calcareous Formation*.—Phyllite, mica schist, graphitic schist, calcareous shale and crystalline limestone are the main rock types of the calcareous formation. Such rocks occupy approximately two square miles near Kalumpang, only a small area, yet larger than was previously supposed. Recent

boring has shown that limestone extends north-westwards along the Sungei Inki valley from Kalumpang to beyond Kampong Kelawai.

The limestone contains variable amounts of magnesia. Two fragments dredged from limestone near Kalumpang, analysed by Mr. G. M. Harral, contained 0.35 per cent. and 0.88 per cent. of magnesia (MgO) respectively; a specimen from the vicinity of Rasa carried 1.15 per cent. of magnesia.

ECONOMIC GEOLOGY OF THAT PART OF ULU SELANGOR COVERED BY SHEET 3 B/7 AND PART OF 3 B/8.

79. The detailed geological survey has enabled areas where prospecting for tin-ore is likely to be successful to be divided from tracts where there is little chance of finding valuable deposits.

80. *The Distribution of Lode Tin-ore.*—A report illustrated by a map on a scale of one inch to a mile on the distribution of tin bearing lodes was prepared. Primary lode tin-ore occurs in the drainage basins of the Selangor and Kerling rivers and this region was sub-divided into three types of country according to the nature of the ore deposits.

- (i) Areas which have yielded rich tin-ore; the lodes already mined have contained between 1 per cent. to 20 per cent. of tin and there is promise of finding further payable deposits. Four such zones, comprising seventeen square miles, should be prospected.
- (ii) Areas containing low grade deposits averaging 0.1 per cent. of tin together with a few richer patches. They comprise some sixty-three square miles of country which is worth prospecting. The four tracts of rich-tin-bearing land are enclosed within this zone.
- (iii) Areas carrying traces of tin-ore and a few patches of low grade ore averaging less than 0.1 per cent. of tin; they are not worth prospecting.

Unfortunately the report and map were lost during the Japanese war and some of the work will have to be re-done.

81. *Prospecting for Tin Deposits and Production of Tin-ore.*—According to the figures published by the Mines Department 19,682 pikuls of tin-ore were produced in 1940 in the region now being described. The output from lode mines was 1,224 pikuls and the remainder was produced from alluvial workings. The lode tin-ore came from small Chinese mines located on the Main Range near the source of the Selangor and Kerling rivers. No mining or prospecting was done by European companies but some of their holdings were sub-leased to Chinese who worked them on tribute.

82. *Graphite.*—Graphite, crystalline carbon, is a common constituent of rocks in the south-west section of sheet 3 B/7 but there are no deposits of commercial value. It occurs as flakes in schist, phyllite, shale and limestone, and more rarely, in quartzite. Rock containing graphite is exposed in the quarry near the Kuala Kubu Road railway station. Graphitic schist specimen 14723 from lot 666 occupied by Tan Poon Chor Estate assayed by Mr. W. A. Tooke, contained 2.25 per cent. of carbon. Such graphitic rocks are frequently mistaken for coal.

83. *Magnetic Cassiterite*.—A magnetic variety of cassiterite occurs in tin-ore concentrates obtained by the Kuala Lumpur Tin Dredging Company near Kalumpang. Ilmenite, leucoxene, tourmaline, zircon, pyrite, pyrrhotite, monazite, andalusite and rutile are present also. The various stages in ore dressing result in there being as much as 28 per cent. of magnetic cassiterite in certain fractions of the concentrate.

THE GEOLOGICAL SURVEY OF THAT PART OF SELANGOR COVERED BY SHEETS 3 B/10, 3 B/11 AND 3 B/12.

84. A general account of the geology of part of the area covered by sheets 3 B/10, 3 B/11 and 3 B/12 was given in paragraph 84 of the Report of the Federated Malay States Geological Survey Department for 1939.

Granite builds the mountains occupying the eastern section of the area covered by sheets 3 B/11 and 3 B/12 and to the west there are granitic intrusions in the sedimentary rocks; emplacement probably occurred during Upper Mesozoic or Lower Tertiary times. There are two groups of metamorphosed sedimentary rocks, the calcareous formation which forms lowlands and the arenaceous formation which builds undulating country; the age of these is thought to range from Permocarboniferous to Triassic. There are roof pendants formed of these rocks resting on granite at Kanching, in Ulu Sungei Batu, in the Sungei Taniu, Ulu Sungei Sleh and Ulu Sungei Gombak. Dolerite and epidiorite occur some two and a half miles north-west of Serendah and amphibole schist and pyroxene schist are associated with rocks flanking granite. There is a small area of Tertiary shale, coal and sandstone at Batu Arang in the south-eastern corner of sheet 3 B/10. Alluvial plains extend westward to the sea from the undulating country built of metamorphosed arenaceous rocks.

85. Cassiterite, the ore of tin, and coal are the chief minerals of economic importance; a little gold is produced and there is some wolfram, scheelite, bauxite and micaceous hematite. The primary tin deposits occur as veins in granite and in the stratified rocks nearby. All tin-ore produced at present comes from alluvial deposits.

THE METAMORPHOSED SEDIMENTARY ROCKS.

86. The oldest rocks are regionally metamorphosed sediments believed to be of Permocarboniferous age: there are others which are probably Triassic. No fossils have been found thus the age of these rocks is uncertain.

87. *The Calcareous Formation*.—Rocks of the calcareous formation consist of metamorphosed calcareous, argillaceous and subsidiary arenaceous material and occupy low-lying country between the border of the granite ranges and quartzite country further west. They have been found underlying the south-eastern section of the Kuala Selangor swamps north of Batang Berjuntai. There are also rocks belonging to this formation in the roof pendant at Kanching and in the south-east

corner of the area covered by sheet 3 B/11 drained by the Sungei Batu. Phyllite, mica schist, graphitic schist, calcareous shale, crystalline limestone and quartz schist are the most common rocks of this formation; a little chert, schistose quartzite, calc-silicate hornfels, tremolite schist, actinolite schist and proxene schist are present also. Exposures are rare except where there is mining, for stanniferous alluvium covers much of the outcrop of this formation. In the valley of the Sungei Garing boring has indicated that metamorphosed sediments shown as Triassic on the 1938 geological map of Malaya, may actually belong to the calcareous formation and thus link up rocks of this formation at Rawang with those north of Batang Berjuntai.

88. Calc-silicate hornfels is associated with limestone, quartz schist, graphitic schist and schistose quartzite in the Kanching roof pendant. The hornfels is altered impure limestone.

89. Actinolite schist and tremolite schist occur in the Sungei Senama some four and a half miles north-east of Ulu Yam Bharu and in tributaries of the Sungei Pedang two miles south-west of this town. Pyroxene schist and actinolite schist are associated with quartz schist and schistose quartzite in tributaries of the Sungei Batu in the Sungei Tua area. At Ulu Yam, Kanching and Sungei Tua the structure suggests that these arenaceous rocks underlie limestone, but more detailed mapping is needed to confirm or disprove this.

90. *The Arenaceous Formation.*—Metamorphosed arenaceous sediments, believed to be of Triassic age, build undulating country covered by the western portion of sheet 3 B/11 and the eastern section of sheet 3 B/10. These deposits were originally laid down as beds of sand and gravel with a few clayey bands; the bulk have been regionally metamorphosed to quartzite, quartzite conglomerate, schistose quartzite, graphitic quartzite, quartz schist and hornstone with intercalations of mica schist and phyllite, but siltstone and shale also occur. Argillaceous rock types, although generally subordinate, are more abundant in low-lying areas than on the hills; thus, on sheet 3 B/11, they are common in the Sungei Garing and Sungei Kuang valleys, in the vicinity of Pengkalan Kundang and in the tract of country extending northwards from Sungei Choh Estate through Bukit Munchong and Kapar Bharu Estates to the area mined by the Southern Kinta Consolidated Tin Dredging Company.

91. Beds of quartzite conglomerate, varying in thickness from a foot to several feet, are interbedded with schistose quartzite in Caledonia Estate situated on the eastern portion of sheet 3 B/10. The conglomerate contains rounded and sub-angular fragments and small boulders of white vein quartz, quartzite and hornstone embedded in a yellowish-grey quartzite cement.

GRANITE.

92. Granite occupies approximately two hundred square miles of the Main Range in the eastern section of the area which is covered by sheets 3 B/11 and 3 B/12. West of these mountains in the Sungei Garing valley there are small granitic intrusions enclosed by sedimentary rocks and at Kuala Selangor, still farther west on sheet 3 B/10, there is an isolated mass of granite.

93. Coarse grained porphyritic biotite granite is the most abundant rock-type; a variety, rich in muscovite as well as biotite, extends in a north-northwest direction from the Sungei Tua area through the Bukit Ulu Gombak ridge to the headwaters of the Sungei Serendah. These coarse granites have been invaded by fine grained granite and granite porphyry in which tourmaline and muscovite are generally present. Small dykes and sills of aplite and pegmatite and numerous veins of quartz cut all the above-mentioned granites.

94. Small areas of coarsely porphyritic biotite granite as well as fine grained granite carrying muscovite and tourmaline, underlie alluvium in the Sungei Garing valley.

95. Granite forms two hills at Kuala Selangor. There are numerous exposures and those in the Public Works Department quarry at Tanjong Kramat are particularly good. The granite is a fine grained variety carrying a little muscovite and biotite and more rarely tourmaline; there are a few phenocrysts of feldspar and some xenoliths of biotite hornfels. Small spherical patches of tourmaline, quartz and feldspar occur, the tourmaline generally being surrounded by a narrow white rim of quartz and feldspar. Small aplite dykes and quartz-sulphide veins traverse the granite. In the Tanjong Kramat quarry the quartz-sulphide veins occupy fractures striking $100^{\circ} \pm 10^{\circ}$; they are lens shaped and average a few inches in width. White quartz and pyrite are the commonest constituents, but arsenopyrite, galena, tourmaline and micaceous hematite are present.

DOLERITE.

96. Dolerite occurs approximately two and a half miles north-west of Serendah in the Sungei Choh and Bukit Munchong Estates, and there are massive outcrops of hard, fresh rock in the valleys of the Sungei Chinchong, Sungei Buaya and Sungei Guntong. Exposures have been found in a zone more than two miles long but the full extent of the outcrop has yet to be mapped.

The dolerite cuts schistose quartzite, quartzite conglomerate and phyllite. Although fresh rock is confined to stream beds the outcrops of dolerite can be mapped because, when weathered it produces a rich, dark reddish-brown clay soil characterised by "crumb texture", easily distinguishable from the yellow or pale brown sandy and clayey soils derived from metamorphosed sediments.

97. The dolerite is a fine grained, hard, compact rock, which is dark bluish-green when fresh, and reddish-brown when decomposed. Pyrite is common, plagioclase, colourless to brown pyroxene and greyish-brown leucoxene are always present; in some varieties green chlorite is abundant in others uranalitisation of pyroxene has resulted in some of the crystals being surrounded by a corona of fibrous green amphibole. In places the dolerite has been altered to epidiorite and at several localities it is cut by bands of amphibole rock as much as six inches wide and several feet in length.

98. The dolerite is intrusive into, and thus is younger than, sedimentary rocks which have been assigned to the Triassic. Dolerite similar to that described above, occurs some four and a half miles north-east of Tanjong Malim. It is intrusive into quartzite near granite and has been metamorphosed; there is no reason to suppose that the metamorphism was not caused by granite.

ECONOMIC GEOLOGY OF THAT PART OF SELANGOR COVERED
BY SHEETS 3 B/10, 3 B/11 AND 3 B/12.

99. The area covered by sheets 3 B/10, 3 B/11 and 3 B/12 contains considerable mineral wealth; the two most important minerals are cassiterite, the ore of tin, and coal; a small amount of gold is also produced. There is some wolfram and scheelite, and bauxite and micaceous hematite have been discovered in addition.

100. *Tin-ore*.—Stanniferous alluvium worked by dredges and open-cast mines, occurs in the valleys of the Selangor, Kerling, Liam, Serendah, Chul, Garing and Kuang rivers which rise in the granite highlands. There are lodes carrying tin in the Main Range granite and in sedimentary rocks bordering the highlands; these deposits were referred to in paragraph 86 of the 1939 Report. Small veins carrying tin-ore are widespread but they cannot be mined profitably at present.

101. *Gold*.—Since 1937 some 18 ounces troy of gold bullion have been recovered as a by-product from dredges mining tin-ore. No parent gold-bearing bodies have been located and there are no alluvial deposits sufficiently rich to be mined for gold alone.

102. *Wolfram*.—Wolfram, tungstate of iron and manganese, is a valuable ore of tungsten. It is associated with cassiterite at Kanching, near Serendah, in the valley of the Sungei Batu about one mile north-west of Batu Caves and in the Sungei Liam valley two miles south-southeast of Ulu Yam Bharu. All these deposits occur either in a thin cover of sedimentary rock resting on granite, or in granite itself close to such rocks. Lodes carrying both cassiterite and wolfram occur near the confluence of the Sungei Gapis with the Sungei Liam, and for some two and a half miles below this place these two minerals occur in the river alluvium. The wolfram and cassiterite are found in lenticular veins of white quartz, generally a few inches in width and several feet in length; some are more than a foot wide but even these rapidly diminish in size and pinch out.

All the veins are not mineralised but those that are usually contain crystals of wolfram as much as six inches long, and cassiterite in crystals as large as one inch across; pyrite, arsenopyrite, tourmaline, muscovite, feldspar and vughs lined with quartz crystals also occur. Most of the veins strike between 130°-310° and 160°-340°, the most common direction being 150°-330°; the average dip is 75° north-east, but some are inclined 40° north-east. These veins are believed to be allied to pegmatites because the minerals forming them are coarsely crystalline and occur in irregular segregations; moreover, a little feldspar occurs.

103. *Scheelite*.—Scheelite, calcium tungstate, another tungsten ore, has been found in the Taik Hing Tin Mine at Kanching and on Lian Hin Tin Mine working lot 315 about one mile north-west of Batu Caves. Limestone overlies granite in both areas but there are several places where it has been removed by erosion. In the Lian Hin Tin Mine scheelite occurs in contact with granite in a zone of metamorphosed calcareous rock, some three feet to five feet wide, which has been impregnated with pyrite, arsenopyrite, tourmaline, cassiterite, wolfram, muscovite and fluorite. Residual scheelite also occurs at the base of the alluvium.

104. *Bauxite*.—Bauxite, hydrated oxide of aluminium was discovered in Sungei Choh Estate some two and a half miles north-west of Serendah.

Yellow and red bauxite concretions, an inch or two in size occur in dark reddish-brown soil; these are irregular in shape, cellular in texture and contain small cavities filled with clay. Associated are nodules and masses of laterite. Bauxite is a superficial deposit and is found overlying dolerite having formed from this rock by weathering. It is thus limited in depth by the extent to which weathering agents have been able to penetrate. A sample analysed by Mr. W. A. Tooke contained:

Al ₂ O ₃	=	58.25	per cent.
SiO ₂	=	10.00	..
Fe ₂ O ₃	=	3.75	..
H ₂ O	=	28.00	..
		100.00	..

This analysis suggests that there is too much silica (SiO₂) for the bauxite to be used as an ore of aluminium. It seems improbable that this deposit will prove to be of commercial importance for it appears likely that it will be confined to the dolerite outcrop described in paragraphs 96 to 98.

105. *Hematite*.—Micaceous hematite in the Public Works Department quarry at Tanjong Kramat, Kuala Selangor occurs as dark reddish-brown crystals lining cavities in quartz-sulphide veins cutting granite. It is not present in commercial quantity.

REPORT OF PROGRESS OF THE GEOLOGICAL SURVEY OF THAT PORTION OF NORTHWEST PAHANG COVERED BY TOPO. SHEETS 2 N/6, 2 N/7, 2 N/8, 2 N/10, 2 N/11 AND 2 N/12 BY J. A. RICHARDSON, GEOLOGIST.

106. The detailed geological survey, scale one inch to a mile, of sheets 2 N/8 (Merapoh) and 2 N/12 (Chegar Perah) was completed in April, 1940, and the investigation of sheets 2 N/6 (Sungei Telom), 2 N/7 (Gunong Bedong), 2 N/10 (Cameron Highlands) and 2 N/11 (Bukit Bujang), commenced in 1937 and 1938, was continued during 1940 and 1941; a portion of the Cameron Highlands District was mapped on the scale of ten inches to a mile, using the special maps issued by the Federated Malay States Survey Department in 1936. The completed geological maps, 2 N/8 and 2 N/12, are now ready for printing, and the memoir dealing with the geology and mineral resources of the area covered by them is being edited for publication. The following report was written prior to the war with Japan.

THE GEOLOGY OF THE MERAPOH SHEET (2 N/8).

107. Geologically, the country covered by sheet 2 N/8 forms a northerly continuation of the Chegar Perah area (2 N/12), described in paragraph 45 of the Report of the Geological Survey Department for 1939. There are the same two sedimentary groups, the calcareous formation which occupies the lowlands, and the arenaceous formation which forms the Main Range foothills in the southwest corner of the sheet. Tuffs, with subordinate agglomerates and lavas, belonging to the Pahang Volcanic Series, are abundant in the calcareous formation, but virtually absent from the arenaceous formation. Intrusive igneous rocks, largely

quartz porphyry, granite porphyry, aplite and associated types, form a mountain range which extends northwards through the middle of the area. Gold, associated with these igneous rocks, has been concentrated in placer deposits, some of them mined in the Sungei Merapoh valley.

The Calcareous Formation.—The rocks of the calcareous formation are divisible into a calcareous facies containing limestone and a few bands of shale and quartzite, an argillaceous facies, predominantly shale, with a few bands of limestone, chert and quartzite, and a "mixed", or transitional facies, comprising interlaminated shale and limestone.

The Arenaceous Formation.—The rocks of the arenaceous formation are interbedded quartzites, conglomerates and shales. Many of the coarser sediments are schistose, and most of the shale has been converted to phyllite or mica schist.

The Pahang Volcanic Series.—Rocks of the Pahang Volcanic Series, most of them fragmental (tuffs), are abundantly interstratified with the shale and limestone of the calcareous formation. Rhyolite tuffs, some of them containing fragments of trachyte and andesite in addition to rhyolite, are the most common volcanic rocks in this area; agglomerates occur in a few localities. Lavas, mainly rhyolite, and, less commonly, trachyte and andesite, are comparatively rare.

Dolerite.—Dolerite occurs as dykes, intrusive into, and therefore younger than granitic rocks in several localities in the headwaters of the Sungei Chiniau.

Quartz Porphyry, Granite Porphyry and Associated Rocks.—A large intrusion of granitic rocks extends from the Sungei Chekua on the adjacent sheet south (Chegar Perah, 2 N/12) into Southern Kelantan. Quartz porphyry is most abundant; granite porphyry is very common; aplite microgranite, granite, adamellite and orthoclase porphyry are less important. Most of these rocks have been sheared in a northerly direction, and the foliation planes dip vertically, or at high angles towards east or west.

Veining by quartz is common in many localities. Most of the veins are narrow, but in some places, such as the eastern tributaries of the Sungei Chadu, they exceed five feet in width.

108. Veins of specular haematite (specularite) occur in igneous rocks in the Sungei Kasai and its tributaries, and in Anak Sungei Terisi.

Some of the igneous rocks are gold-bearing, for placers, such as those mined in the Sungei Merapoh valley, lie in the lowlands immediately adjacent to the hills occupied by this intrusion.

GEOLOGY OF THE SUNGEI TELOM (2 N/6), GUNONG BEDONG (2 N/7), CAMERON HIGHLANDS (2 N/10) AND BUKIT BUJANG (2 N/11) SHEETS.

109. These four sheets comprise almost 600 square miles, in northwest Pahang, bounded on the north by Kelantan territory, on the west by Perak territory, on the east by sheets 2 N/8 and 2 N/12, and on the south by sheets 2 N/15 and 2 N/16 which are being examined by Mr. Service. The area lies on the eastern flank of the Main Range, and thus most of it is occupied by granite. With the exception of a few small roof pendants of hornfels and schist, believed to belong to the calcareous formation, between Ringlet and Tanah Rata, and in Ulu Sungei Terla, Cameron Highlands District, sedimentary rocks and their metamorphosed equivalents are confined to a strip of country, some five miles in width, which lies between the granite and the eastern margin of the area. The arenaceous formation, well

developed in the Main Range foothills, is separated from the granite by a series of quartz schists, mica schists, phyllites and amphibole schists. Their stratigraphical position is uncertain.

The arenaceous and pelitic schists may be two facies of the arenaceous formation. They may, however, belong to the calcareous formation for they resemble some of the schists associated with metamorphosed calcareous rocks at Cameron Highlands. There is considerable doubt concerning the genesis of the amphibole schist series. These rocks may be metamorphosed sediments of the calcareous formation or of the Pahang Volcanic Series, altered basic rocks such as dolerite or basalt, or hydrothermally altered serpentine; further work may enable this question to be settled.

110. Tin, gold and a little cinnabar occur in a tract of country flanking the granite. There are no mines in the area, but gold-stealers have been working in several rivers on sheet 2 N/11.

111. *The Calcareous Formation.*—Argillaceous limestone, intercalated with phyllite and quartzite in a tributary of the Sungei Sua (Sheet 2 N/11) is the only calcareous rock of undoubted sedimentary origin so far located in the outcrop of metamorphosed sediments which lies between the granite and the Main Range foothills. Metamorphosed rocks which were originally calcareous sediments occur in roof pendants in the Cameron Highlands District. Banded schist and hornfels, containing biotite, pyroxene, amphibole, epidote and garnet, are exposed between milestones 34½ and 34¾ on the road from Tapah to Tanah Rata, and similar rocks crop out in Ulu Sungei Terla. Quartz schists, mica-quartz schists and quartz-mica schists form the bulk of the roof pendants at Cameron Highlands, and they appear to be interbedded with the calc-silicate schists and hornfels described above.

112. *The Arenaceous Formation.*—As in the adjacent sheets, 2 N/8 and 2 N/12, the arenaceous formation comprises quartzite and conglomerate, commonly schistose, inter-stratified and infolded with shales which have been converted to phyllite and mica schist.

Although their stratigraphical position is not yet clear, the metamorphosed arenaceous and argillaceous rocks, represented by sheared quartzite, quartz schist, mica-quartz schist, graphite-quartz schist, graphite-mica-quartz schist, phyllite, mica schist, graphite-mica schist and quartz-mica schist, which lie between the Main Range foothills and the granite, are included, provisionally, with the arenaceous formation. Detailed mapping has revealed that the quartzose and argillaceous rocks occur as lenticular bands elongated north and south and that the structure is complex.

113. *The Amphibole Schist Series.*—Actinolite schists occupy several square miles in the drainage basin of the Sungei Telom between the Sungei Merkoh and the Sungei Tekai.

In the Report of the Geological Survey Department for 1937 it was suggested that these schists have been formed by the regional metamorphism of dolerite. It is possible, however, that they are altered calcareous rocks such as shales and tuffs, or hydrothermally changed serpentine, and, until more evidence is available their true mode of origin cannot be decided.

114. *Granite*.—Granite covers about three quarters of the area. Most of it is medium grained or coarse grained biotite granite, moderately or strongly porphyritic. There are many other varieties of which most important are tourmaline granite, fine grained granite, non-porphyritic granite, microgranite, aplite, foliated granite and flow-banded granite. None of these less important varieties seems to occur in masses sufficiently large to be depicted on the geological map, scale one inch to a mile, a respect in which this portion of northwest Pahang differs radically from the area in Ulu Selangor mapped by Mr. Roe; there, three main types of granite have been demarcated.

The Main Range granite appears to be the only formation which has any economic value. Tin-ore has been shed from a marginal zone where granite is in contact with sedimentary rocks, but the bulk of the granite outcrop seems to be barren of cassiterite; a little gold and cinnabar may accompany the cassiterite. There are no mines working lode or placer tin deposits at present.

115. *Dolerite and Serpentine*.—An intrusion of dolerite, rather more than one mile in diameter, and several small masses, occur between the Sungei Tekai and the Sungei Jelai Kechil, sheet 2 N/11; this rock has not yet been located elsewhere in the area. Small lenticular outcrops of serpentine have been discovered in a tributary of the Sungei Tempoi, and in the valley of the Sungei Jelai Kechil, sheet 2 N/11.

ECONOMIC GEOLOGY OF THAT PART OF NORTH-WEST PAHANG
COVERED BY SHEETS 2 N/6, 2 N/7, 2 N/8, 2 N/10, 2 N/11
AND 2 N/12.

116. *Production of Gold*.—Six alluvial gold mines were in operation during 1940, four of them in the Sungei Merapoh valley (sheet 2 N/8), one in the Sungei Timah valley and one in the Sungei Tui valley (sheet 2 N/12); there was no mining elsewhere. The output in ounces troy from individual mines, according to figures supplied by the Mines Department, is tabulated below.

Mine.	Production (ounces troy).	
	1940.	1941.
Foo Brothers Hydraulic Gold Mine	510 ounces	733 ounces
Tui Gold Limited	170 "	2,129 "
Merapoh Gold Mine, Limited	237 "	69 "
Hup Lee Kongsi Gold Mine	26 "	Nil
Merapoh Kongsi Gold Mine	92 "	Nil
Poh Cheong Heng Gold Mine	15 "	Nil

Tui Gold Limited came into production in October, 1940.

117. *The Prospects of finding Payable Gold Deposits*.—The chances of finding payable gold lodes and valuable gold placers in the area covered by sheets 2 N/8 and 2 N/12 have already been discussed in paragraph 47 of the Report for 1939. The prospects are not good, but small payable placers may yet be discovered in the alluvium of rivers draining from quartz porphyry, granite and associated rocks exposed between the Sungei Chekua and the Kelantan border, from granite in the southeast quadrant of sheet 2 N/12 and from the syenite intrusion north of the Sungei Jelai.

118. *The Prospects of finding Payable Deposits of Tin-ore.*—There is a chance of finding payable tin-ore placers in the strip of country flanking the Main Range granite in the Sungei Jelai Kechil, Sungei Telom and Sungei Bisek drainage basins on sheets 2 N/7 and 2 N/11, but, so far, there seems to be little likelihood of locating valuable deposits in the portion of Pahang covered by sheets 2 N/6 and 2 N/10.

119. *The Prospects of finding Payable Deposits of other Minerals.*—Iron-ore (haematite, specularite, and limonite), galena (lead ore), sphalerite (zinc ore), scheelite (ore of tungsten) and cinnabar (ore of mercury) occur in the area covered by sheets 2 N/8 and 2 N/12 but none is present in sufficient quantity to be of any commercial value.

REPORT OF GEOLOGICAL WORK IN SOUTHERN KELANTAN.

120. Two Rock collectors of the Federated Malay States Geological Survey Department spent nearly two weeks in 1940 in southern Kelantan. The area visited by them lies between the Sungei Galas and the Sungei Nenggiri (Sungei Brok); it is bounded on the north by the Sungei Kundor and the Sungei Pelar, and extends southwards almost to the Pahang State boundary. It forms a northwards continuation of sheet 2 N/8. The rivers examined include the Sungei Nenggiri and its tributaries the Sungei Pelar, Sungei Badong, Sungei Lebak, Sungei Embeh (Sungei Pleh) and Sungei Raya, and the Sungei Galas and its tributaries the Sungei Kundor, Sungei Charalong (Sungei Chalong), Sungei Sunting, Sungei Lanjut, Sungei Semur and Sungei Tuang.

121. This portion of southern Kelantan is built partly of sedimentary rocks and partly igneous rocks. The stratified deposits include shale, limestone, and more rarely, chert, belonging to the calcareous formation, and continuous with the outcrop of these rocks already described in that section of the report which deals with the geology of the Merapoh Sheet (2 N/8), Pahang (paragraph 108). In some localities, rhyolitic and argillaceous tuffs, belonging to the Pahang Volcanic Series, are interbedded with these sediments.

All the intrusive igneous rocks located here are of granitic composition. They include muscovite granite, quartz porphyry and granite porphyry, the most abundant, and, in addition, aplite and microgranite.

Quartz porphyry and granite porphyry are best developed in the upper waters of the Sungei Galas; granite forms a large outcrop on Bukit Sunting and in the Sungei Kundor.

122. Alluvial concentrates were panned from most of the rivers, and the minerals contained in them consist chiefly of ilmenite and zircon, together with variable amounts of limonite, epidote, tourmaline and gold; magnetite is abundant in some concentrates. Boulders of specular haematite (specularite) occur in the alluvium of the Sungei Galas.

REPORT ON THE GEOLOGICAL SURVEY OF THE PART
OF NORTH-WEST PAHANG COVERED BY TOPO.
SHEETS 2 N/15, 2 N/16, 2 O/13, 3 B/3 AND 3 C/1 BY
H. SERVICE, GEOLOGIST.

123. Field work over Topo. sheets 2 N/15, 2 N/16, 2 O/13, 3 B/3 and 3 C/1 on a scale of one inch to a mile was continued during 1940 and 1941 with the result that the geological survey of sheets 2 O/13 and 3 C/1 was almost completed; a considerable amount of work was done on sheet 2 N/16, and reconnaissance traverses were made over parts of sheets 2 N/15 and 3 B/3. In addition to carrying out normal field mapping, examinations were made of the working gold mines in the area, and a check was kept upon the prospecting for tin and gold which was carried out in several places. Two months of the year 1940 were spent at the Headquarters of the Geological Survey Department at Batu Gajah and two months in military camp at Raub.

124. Collections of fossils were made at five new localities in the Lipis sheet 2 O/13, largely through the work of Che Yeop bin Uda Rasit and Che Kassim bin Majid. Reports from the British Museum on the fossils in these collections and in those made during the previous year have yielded much stratigraphical information, which has helped in the determination of the major fold-structures of the area. It now appears that Triassic rocks are more widespread than was suspected when the statement was made in paragraph 53 of the 1939 Report that more than three-quarters of the area covered by Topo. sheet 2 O/13 is occupied by shales, mudstones, tuffs and intercalated small bands of limestone thought to be of Permocarboniferous age.

125. Mineral production in the area was confined to gold, the output of which, in 1940, 824 ounces troy of gold bullion, was considerably less than that for 1939. The bulk of the gold was obtained from the Kechau, the Penjom and the Sungei Mutan mines, all of which are opencast or gravel pump propositions. No gold was produced by underground mining.

GEOLOGY OF THE LIPIS AND BENTA SHEETS 2 O/13,
2 N/16 AND 3 C/1.

126. *General Geology.*—Recent work shows that nearly half, and possibly more than half, of sheet 2 O/13 is covered by Triassic beds, chiefly sandy shales and mudstones with bands of quartzite and argillaceous conglomerate, and with zones of interbedded lavas and tuffs and some limestone. In the report for 1939, the Triassic beds were correlated with the "Arenaceous Formation" of quartzites, conglomerates, phyllites, shales and cherts which form a prominent series of foothills along the eastern edge of the Main Range granitic intrusion. It is here proposed, however, to cancel this correlation and to call the arenaceous beds on sheets 2 O/13 and 3 C/1 simply "Triassic

beds", because evidence is accumulating to indicate that the beds of the arenaceous formation in the Main Range foothills are much more ancient, probably Permocarboniferous or even older.

The Triassic beds are best developed near the western edge of sheet 2 O/13 where they occur in a syncline with axis passing approximately through Kuala Lipis. Determinative fossils have been located along this strip at the 1 mile, 3 mile and 3½ mile pegs on the road from Kuala Lipis to Benta, and in Sungei Perenggan on the north side of the Sungei Jelai near Kuala Lipis. East of the syncline of Triassic beds is a broad zone of shales, limestones, tuffs and lavas of Permocarboniferous age, but still further east, in the south-east portion of the sheet, Triassic beds are again folded down between Batu Balai and the Sungei Som. Three fossiliferous localities have been discovered in this second Triassic belt, one on the Sungei Som and two others about 1½ miles west of Batu Balai.

The Permocarboniferous rocks separating the two areas of Triassic beds described above are shales and mudstones with much interbedded volcanic material and many small intercalations of limestone. The correlation made in the annual report for 1939 for these rocks with the Permocarboniferous "calcareous formation" described by Richardson is retained, and their age has been confirmed by Dr. R. L. Cox after examination of fossils collected at two new localities. Similar rocks outcropping at Lubok Sukum, on the Pahang River near the eastern edge of sheet 2 O/13 are stated by Scrivenor to contain Permian fossils ("The Geology of Malaya", 1931, p. 56).

On sheet 2 N/16, Permocarboniferous shales and limestones with interbedded volcanic rocks, are predominant. The Triassic beds on the western limb of the syncline passing through Kuala Lipis overlap for a short distance from sheet 2 O/13 on to the eastern edge of sheet 2 N/16, while quartzites, conglomerates, shales and cherts of the Main Range Foothills form a narrow strip down the western edge of the sheet. The remainder of the sheet apart from two areas of granitic rocks is occupied by Permocarboniferous beds, which are directly continuous with those of the calcareous formation described by Richardson on the Raub sheet, 3 B/4, immediately to the south.

127. *Structure*.—The beds on sheet 2 N/16 occur in folds trending slightly east of north and with limbs showing dips to east and west of angles between 30° and vertical. There appears to be slight overfolding in parts, but generally the folding is fairly steep and open. It is noteworthy that folding on the Raub and Chegar Perah sheets mapped by Richardson to the south and north, respectively, of sheet 2 N/16, is much stronger. The reason for this is that on the Raub sheet the beds have been crushed between the Main Range and the Benom Range granitic intrusions, and on the Chegar Perah sheet between the Main Range granite and several smaller intrusions of granite, syenite and quartz porphyry; on the intermediate sheet 2 N/16, however, where the effect of the Benom intrusion is slight and where other minor intrusive masses are few, the crushing effect is smaller and folding is therefore less intense.

128. *Stratigraphy*.—As a result of the comparatively open nature of the folding on sheets 2 N/16, 2 O/13 and 3 C/1, it has been found possible to deduce the major fold-structure and to make a broad stratigraphical sub-division of the sedimentary rocks in the area. This is as follows:

Triassic beds.—

6. Sandy shales and mudstones, argillaceous quartzites and conglomerates, with minor bands of tuff and probably some limestone. Best developed along the western edge and in the eastern and south-eastern parts of sheet 2 O/13 and 3 C/1.

Permocarboniferous "calcareous formation".—

5. Shales, mudstones and volcanic rocks, with minor developments of limestone. The volcanic rocks are mostly semi-basic or basic tuffs, but lavas are common in places near the top of the group, notably in the Kechau valley. Developed together with groups 4 and 3, in the central parts of sheet 2 0/13.

4. "Upper limestones" shales and minor basic tuffs. Developed near Padang Tungku and folded synclinally to appear, firstly, in the Sungei Telang and Sungei Kelidik valleys and secondly, in the Sungei Bertam valley.

3. Shales and tuffs with minor limestone bands. Developed between Padang Tungku and Sungei Telang on either flank of the Bukit Petri granite intrusion and in the Sungei Koyan and Sungei Paga valleys.

2. "Lower limestones" and shales which typically occur in a "mixed facies" (see Richardson, paras. 107 and 111) of strongly banded, thinly bedded limestone and shale, but which also contain several large areas of limestone. Developed along a belt averaging some four miles in width alongside the road-trace from Kuala Medang to Batu Talam.

"Arenaceous Formation".—

1. Quartzites, conglomerates, phyllites, shales and cherts and their more strongly metamorphosed schistose and hornfelsic equivalents. These rocks form a strip extending from the Main Range granite intrusion eastwards across the eastern half of sheet 2 N/15 and overlapping for some two miles along the western edge of sheet 2 N/16. Formerly regarded as being of Triassic age, by analogy with the arenaceous Triassic beds found near Kuala Lipis and elsewhere in Malaya, they are now considered to be probably older than the Permocarboniferous "calcareous formation". The point is not yet settled.

So far as can be determined at present, there is no sign of unconformity between the Permocarboniferous "calcareous formation" and the Triassic beds. The junction seems to be transitional and reconcilable with a general and gradual lowering of sea level with consequent increase in supply of arenaceous material. On the other hand, Richardson suspects an unconformity between the "calcareous formation" and the "arenaceous formation" of the Main Range Foothills (1939 report, para. 45).

129. *Intrusive Igneous Rocks.*—At its northern end, the granite of the Benom Range forks into two parts, of which the eastern extends northwards for approximately one mile into the south-west corner of sheet 2 0/13: the western fork carries on in a thin belt, averaging two miles in width, into the south-eastern part of sheet 2 N/16, and continues northwards in a very irregular, narrow mass for some ten miles before it dies out. The eastern mass forms the hills on the south side of the road from Benta to Jerantut between the 21st and 29th miles: the western mass forms the hilly country between Benta and the 21st mile on the road to Raub and, in its northern extension, Bukit Jerkoh and Bukit Lima. Biotite granite is the predominant rock-type in these two masses, but syenite and hybrid rocks are plentiful in the southern and eastern part of the western mass.

A few other, smaller masses of biotite granite occur on sheets 2 0/13 and 2 N/16, the biggest of which are those forming the Bukit Petri hills between Sungei Kelidik and Sungei Bertam, and Bukit Poh, on the eastern side of Sungei Lipis two miles south of Kuala Lipis.

130. Only slightly less abundant than granites are quartz porphyries which are strongly developed in the eastern half of sheet 2 O/13. They form a big mass running southwards some two and a half miles in width, from the north edge of the sheet through Bukit Kayu Ara and Bukit Damar to cross the Sungei Jelai between Sungei Kenong and Sungei Lau: the mass narrows to about one mile in width where it crosses the railway line between the 131½ and 133 mile pegs, and eventually fingers out 5 miles further south-half a mile below the mouth of Sungei Putu. At its southern end the strike of the intrusion swings round from north to north-west.

In the area to the south and south-east of the big intrusion described above, at least twelve other smaller intrusions of quartz-porphyry and similar rocks have been located. Nearly all of these are long, narrow masses following approximately the trend of a strong zone of shearing which extends right across the sheet and which is particularly well marked in schist and phyllite exposed on the railway line between the 133 and 137 mile pegs. Those parts of the intrusion lying within the zone of shearing are sheared and in places reduced to quartz-sericite schists, but outside the limits of the shear-zone the rocks are massive. It would appear, therefore that intrusion preceded shearing. None of the quartz-porphyries have been seen in contact with the granites so it is impossible to say exactly which are the older. From the partial or complete recrystallization of the ground mass constituents of most of the unsheared porphyries, however, it seems likely that they are older than the main granites, most of which are but little altered.

131. *Gold*.—Alluvial gold is widely distributed over the whole of the area covered by sheets 2 O/13, 2 N/16 and 3 C/1: presumably the majority of it is derived from quartz veins too small to locate in the field; for few have ever been found. Some gold definitely is associated, however, with a particular type of minor intrusive, namely, muscovite-aplite ("quartz-mica rock") which is exposed in the alluvial gold-workings at Penjom, Sungei Mutan and Ketir. Recent observations indicate that the gold mined on these properties is derived by weathering of small quartz veins which form stockworks in aplite dykes and the nearby sedimentary rocks. Recognition of natural, surface exposures of muscovite-aplite is, unfortunately difficult because the rock weathers readily to a micaceous clay which is very easily mistaken for a weathered sandy-phyllite or fine grained micaceous quartzite.

PROGRESS REPORT ON GEOLOGICAL WORK IN SOUTH-WEST PAHANG BY J. B. ALEXANDER, GEOLOGIST.

132. The total area under examination in this district prior to the Japanese occupation of Malaya amounted to approximately 860 square miles of country. It included those parts of Pahang represented on Topographical Sheets 3 B/8 (Bentong), 3 B/12 (Genting Sempak) 3 B/16, 3 C/9 (Karak), and 3 C/13 (Manchis).

Whilst the greater portion of the time between August, 1939, and December, 1941, was devoted to making a detailed study of the area covered by Topo. Sheets 3 B/8 and 3 B/12, interruptions in the progress of this work were occasioned by special investigations in other districts and by two periods, each of two months duration, of embodied military training. Four months were taken up by the coal-boring investigation in the Bukit Arang area of Perlis. Another two weeks were spent to assist in the location of suitable quarry-sites for supplying road-metal to the new Temerloh-Maran road, construction of which was commenced by modern methods in 1941 for strategical military considerations.

Apart from the usual fieldwork, a total period of about eight weeks during 1940 and 1941 were occupied by the examination of the diamond-drill cores obtained from the various mining properties of the Bentong district. A total of 8,652½ feet of cores from the Chagar, Ayer Hangat, Murai and Manchis mines were inspected in detail during 1940, and a further 7,933 feet from Ulu Perting, Kubang, Terling, Ayer Hangat and Murai during 1941. The close examination of these cores has been useful in showing that, at Chagar and Ayer Hangat, there has been a definite period of partial resorption of the medium to coarse-grained biotite granite by the later, more fluid, magma which intruded the former and finally solidified as the finer-grained varieties of granite and granite porphyry. It is unfortunate that 3,202 feet of cores drilled in the Ulu Bakau and Ulu Penjuring areas during 1939 were not split and part reserved, but were crushed to powder for assaying before a detailed examination could be undertaken.

Loss, as a result of the Japanese occupation of Malaya, of practically all the notes compiled during 1939 to 1941, has necessitated the duplication of fieldwork over the 3 B/8 3 B/12 area which had been almost completed in 1941. Detailed notes of rock-core examination, as well as mine working plans from Chagar, Ayer Hangat, Murai and Manchis, and also some of the alluvial boring plans from other parts of the district, have all been lost and cannot be replaced.

The Bentong office was re-established on the 20th July, 1946, and work in the area since that date has been concentrated on the re-examination of the 500 square miles of Pahang shown on Topo. Sheets 3 B/8 and 3 B/12. On account of considerable difficulties with regard to the recruiting of labour for jungle work, due mainly to the rice shortage, fieldwork during 1946 has been confined to the more readily accessible portions of the area. Detailed mapping of the granite-sedimentary contact and the inter-formational boundary between the Schist and the Quartzite Series has now been completed. This leaves for examination during 1947 the calcareous formation east of the quartzite foothills in 3 B/8 and the sedimentary roof-pendant areas of 3 B/12.

THE GEOLOGICAL SURVEY OF THAT PART OF SOUTH-WEST PAHANG REPRESENTED ON TOPOGRAPHICAL SHEETS 3 B/8 AND 3 B/12.

133. The general features of the district have been already outlined in paragraphs 64 to 71 of the Annual Report for 1939.

GEOMORPHOLOGY IN RELATION TO GEOLOGY.

134. Both geomorphologically and geologically the area under survey falls into three main divisions comprising first, the Main Range highland granite area, second, its eastern foothills composed of metamorphosed stratified beds of the Arenaceous Formation, and third, a broad bordering belt of low-lying country built up of stratified beds of the Calcareous Formation farther to the east. The Main Range massif itself varies in width from approximately twelve to twenty miles and rises up to peak elevations of more than 5,000 feet on the inter-State border between Pahang and Selangor, amongst the highest being Gunong Rajah (5,526 feet) and Gunong Ulu Kali (5,820 feet), while the lowest passes stand at over 2,000 feet, amongst which may be mentioned the Gap (2,793 feet), Ginting Sempak (2,080 feet), and Ginting Bidai (2,260 feet). On its eastern flank the Main Range is bordered, over a width of two to four miles, by comparatively low foothills, in places showing as distinct well-developed narrow ridges rising up to maximum elevations of only 2,000 feet, usually not more than 1,500 feet. The bordering belt of low-lying rolling country, nearly twelve miles in width, extends eastwards to the western foothills of the Gunong Benom Range

and stands at an elevation usually not above 500 feet, although there are few isolated hills rising to a little over 1,000 feet. All these features follow a general trend aligned parallel to a 330°-150° direction.

A study of the dissection patterns of the river systems reveals that, in the Main Range granite areas, the most prominent directional trends of the streams in the northern section run between east-southeast and east, or between south-southwest and south while the hills trend generally 330°-150°. In the southern section they run between east and east-northeast, or are southerly, while the hills and a few streams trend generally 315°-135°. These directional trends agree very well with the common directions of jointing and fracturing. In the foothills and lowlying country the most prominent trends of the streams are between south-southeast and southeast or between east-northeast and northeast; that is, with the exception of local minor variations, parallel to, or at right angles to, the general trend of the hill ranges, corresponding to the general directions of strike and dip of the stratified rocks, which usually have steep easterly inclinations.

GEOLOGICAL HISTORY.

135. The geological history of that part of south-west Pahang under survey may be summarised provisionally as given in the table below, which should be read from below upwards, since the youngest strata are shown on the top and the oldest at the bottom.

Post middle pleistocene and recent.	I.—Deposition of recent alluvium by sub-aerial denudation, during which period the present existing topography was formed. This alluvium may contain tin-ore and gold, although it is rare for the latter to be present even in small amounts.
	H.—Deposition of unconsolidated volcanic ash, blown from the shattered volcano now occupied by Lake Toba in Sumatra. No actual occurrences have been recognised, as yet, in the areas covered by sheets 3 B/8 and 3 B/12, but this ash occurs at Kampong Dong in sheet 3 B/4 and there are indications of similar deposits along the Mentakab road in sheet 3 C/9.
Middle pleistocene.	G.—Deposition of older alluvium by sub-aerial denudation, during which period a less mature form of the present topography was moulded. As with the recent alluvium, tin-ore and small amounts of gold may be present.
Pre-middle pleistocene.	..... UNCONFORMITY.....
Post-Triassic.	F.—Intrusion of ophitic dolerite at a few small isolated localities in the foothills of the Main Range.
	E.—Tectonic and igneous activity which was responsible for the formation of the Main Range mountains and their associated ore-deposits. This occurred in stages as follows; (ix) Hot springs remaining active to the present day. (viii) Minor faulting in the consolidated igneous complex. (vii) Local zeolitisation. (vi) Release of hydrothermal carbonated waters with the formation of argentine, the pearly lamellar variety of calcite. (v) Injection of hydrothermal siliceous solutions forming quartz dykes and veins, generally barren, but occasionally auriferous. Vein quartz is abundant in the schists and phyllites, but only rare in the limestone; it is common in shatter zones in the granite.

Post-Triassic.

- (iv) Cassiterite pneumatolysis accompanied by earth movements, resulting in :
 - (b) the intrusion of small cassiterite-bearing quartz veins carrying also tourmaline, mica, and arsenopyrite, into the sediments of the contact zone.
 - (a) the formation of stanniferous greisen and schorl veins and stringers, mainly by replacement of the granite along fracture walls.
- (iii) Earth movements giving widespread folding, faulting, and shattering;
 - (b) causing a shearing of the coarser varieties of granite with the production of granite gneiss, mylonite-gneiss, mylonite, and quartz-chlorite-epidote-clinzoisite-sericite schist.
 - (a) pressures were relieved mainly by fracturing in the finer-grained varieties of granite.
- (ii) Intrusion of the Main Range granite magma; crystallisation and differentiation commenced. Cooling and progressive solidification, sometimes with intermediate periods of partial resorption, induced the differentiation of the magma into the following forms
 - (d) Pegmatite, aplite, and felsite;
 - (c) Granite-porphyry and fine-grained granite;
 - (b) Sparsely porphyritic medium-grained granite;
 - (a) Coarse porphyritic biotite granite;

During consolidation fluidal movements, under favourable circumstances, may have produced fluxion banding and gneissose granite.
- (i) Widespread mountain-building movements, commencing before, and persisting until long after, the emplacement of the granite. The commencement of these movements caused the development of schistosity and foliation in the adjacent sedimentary rocks.

Post permo-carboniferous.

- D. (ii) Alteration of certain members of the basic group, including diallage-rock, to form massive serpentine.
- (i) Intrusion of a basic group, dolerite and, possibly, diallage-rock, into the Arenaceous Formation of the Main Range eastern foothills and into the Calcareous Formation.

Triassic.

- C.—Deposition of a second predominantly arenaceous series, sometimes with interbedded rocks of the Pahang Volcanic Series. Vulcanicity decreasing.
- Fossils have been found in this series in the Kuala Lipis area.

Permo-carboniferous.

- B.—Deposition of a calcareous and argillaceous series with interbedded rocks of the Pahang Volcanic Series. Vulcanicity at a maximum.

Regional metamorphism has, in some places, converted the original sediments into crystalline limestone, phyllite, or schist.

A.—Deposition of a predominantly arenaceous series with occasional interbedded rocks of the Pahang Volcanic Series. Volcanicity increasing.

Carboniferous.

Regional metamorphism has converted the original sediments into a series of quartzite-conglomerates, quartzites, phyllites, and schists. Chert is commonly found in the form of bands interbedded with quartzite and phyllite at certain localities in the eastern foothills of the Main Range. No fossils have been found in this series up to the present, so that its age is unproven as yet.

136. The various types of rocks occurring in the main formations have already been detailed in paragraph 65 of the Annual Report for 1939. Later work has resulted in the encountering of similar types, together with a few others not previously recorded, of which the chief is the serpentine rock found occurring within the rocks of the Arenaceous Formation of the eastern Main Range foothills, east of the Bentong-Karak road and near the boundary of Topo. Sheets 3 B/8 and 3 B/12.

137. During the course of detailed fieldwork on the granite-sedimentary contact and the interformational boundary between the Schist and Quartzite Series, it has been noted that neither a single trace of calcareous sediment, nor of altered calcareous sediment, has been encountered in the section between the Main Range proper and the quartzite foothills. Limestone bands are, however, quite frequently encountered immediately to the east of these foothills. Schists and phyllites usually dip steeply to the east. Chert bands are exposed more commonly on the west than on the east side of the main quartzite ridge, while chert pebbles are found in the quartzite conglomerate which occurs more frequently on the east side of the foothills. These observations would appear to indicate that the arenaceous formation present in this part of Malaya is older than the calcareous formation of Permian-Carboniferous age and, furthermore, that there are really present in the country two periods of predominantly arenaceous deposition with similar lithological characteristics. Unfortunately no fossils can be found to date in any part of these foothills which would prove or disprove this opinion.

ECONOMIC GEOLOGY.

138. The mineral of primary importance to mining in the Bentong district is cassiterite, tin oxide, the common ore of tin. The annual figures of production of tin-ore from this district since tin restriction came into force in 1931 are given below in pikuls (one ton=16.8 pikuls):

1931	...	6,179	1939	...	6,941
1932	...	4,506	1940	...	8,913
1933	...	3,939	1941	...	7,651 (incomplete)
1934	...	5,067	1942	...	644
1935	...	7,704	1943	...	47
1936	...	11,244	1944	...	—
1937	...	12,842	1945	...	—
1938	...	6,675	1946	...	—

The chief forms of mineralisation in the district have already been described in paragraph 66 in the Annual Report for 1939. Examination of the Perting valley mining areas has shown, as clearly evidenced at Ulu Perting, Terling, Ayer Hangat, Chagar, and other localities, that the main development of the zones of mineralisation follows a south-easterly or east-southeasterly trend, with a subsidiary series sometimes present and striking south-south westerly. The lode-channels are usually of low-grade mineralisation and may consist of a single stringer, or of several parallel cassiterite-bearing quartz-tourmaline stringers and veins spread over a width of several feet, each separated by a greater or lesser thickness of barren ground. Local enrichments are sometimes found in favourable localities at the intersections of two series of stringers and may form pipe-like bodies of payable ore.

A few colours of gold were found along the Sungei Kedut, in shale and limestone country of the Calcareous Formation. This stream is a small south-flowing east-bank tributary of the Sungei Bilut in the area covered by the upper half of Topo Sheet 3 B/8; it is unnamed on this map. There is evidence of old sporadic digging in the vicinity thereof.

PROSPECTING AND MINING ACTIVITIES.

139. Although a large number of the lower-grade mining leases in the Main Range were abandoned when working became unprofitable after tin restriction came into force in 1931, a few were still being worked, at the time of the Japanese invasion in 1941 by methods differing very little from those originally adopted by the Chinese miners during the earlier part of the current century. The chief method employed by these miners was that of ground sluicing ("lampan-mining"), an operation requiring as its only essential a good supply of water above the level of the ground to be worked. This water is run over the soil, eluvial detritus, and decomposed tin-bearing rock, in order to wash away the barren particles of its lighter constituents, leaving a concentrate of the heavier minerals including the tin-ore. This process could still be seen in operation during 1941 at the Ulu Perting and Terling valley, and at several small holdings in the Repas and Lebah basins. Where the progress of such operations, after the soil and eluvial detritus had been removed, exposed well-defined zones of mineralisation in the semi-decomposed and hard undecomposed granite, a few of these original lampan-workings eventually developed into shallow lode-workings and crushing of the tin-bearing rock became necessary in order to release the tin-ore. For this purpose the early Chinese miners employed primitive water-box stamps or water-wheel stamps, a few of which were still in use in 1941 on properties in the Perting basin, as at Ayer Hangat, Terling, and Ulu Perting. Some of the mines, notably Chinchong, Chagar, and Murai, came under European influence shortly after the first world war and power-driven batteries of Californian-type gravity-stamps were installed for crushing the ore.

140. Many of the old lampan-workings and shallow lode-workings in the Main Range, as well as several areas of alluvial ground in the Kenong, Perting, and other valleys, together with a larger dredge-area in the lower reaches of the Bentong river,

were taken over by Straits Tinfields Limited and actively prospected during the period 1939 to 1941. Diamond-drilling and underground tunnelling developments were undertaken on some of the lode properties, extensively at Chagar and Ayer Hangat, in addition to the usual methods of surface pitting, while a considerable amount of boring, and some pitting, was done in the alluvial areas.

The Chamang hydro-electric power station, built originally for the use of the Bentong dredge, and situated near where the Sungai Perting debouches from the Main Range, was closed down when dredging operations were concluded in 1939, but was taken over by Straits Tinfields Limited and, after overhauling and thorough reconditioning, was to have been utilised for providing Chagar and Ayer Hangat mines with cheap power. Power lines had been erected in 1941 to connect with Chagar and Ayer Hangat, but unfortunately war intervened and the entire installation, in common with mining machinery from all the mines in the district, was either looted or destroyed.

141. *Chagar and Ayer Hangat Tin Mines.*—The annual figures of production from these two properties during recent years are given below in pikuls of tin-ore:

			Chagar.		Ayer-Hangat.		Total.
1936	...	...	1,169	...	562	...	1,731
1937	...	...	1,002	...	561	...	1,563
1938	...	...	923	...	348	...	1,271
1939	...	...	431	...	215	...	646
1940	...	...	189	...	32	...	221
1941	...	...	258	...	926	...	1,184
1942	...	...	39	...	—	...	39
1943	...	...	11	...	—	...	11
1944-1946	...	...	Nil	...	Nil	...	Nil

Until taken over by Straits Tinfields Limited, the Chagar property was held by two separate concerns, each with their own power-driven five-head stamp-battery for crushing ore obtained from the shallow lode-workings. At the same time each also did a certain amount of monitor-slucing of the decomposed ground lying along the extension of the exposed lode-channels. These operations were still being continued in a modified form under tribute whilst underground development was proceeding. A total of 5,567 feet of diamond-drilling, in nine holes, had been put down, in addition to which underground tunnelling development of the downward extension of two main lode-channels, at the end of 1940, amounted to 1,174 feet of crosscuts, drives, winzes and raises, in ore, together with 1,007 feet of crosscutting in the granite country-rock. Reserves blocked out along the main lode-channel amounted to 62,010 tons, averaging only 0.32 per cent. tin over a width of 99 inches, of which 49,194 tons averaged 0.35 per cent. tin over 103 inches, while in the second lode-channel 2,695 tons averaged 0.32 per cent. over a width of only 54 inches. The erection of a modern mill, consisting of a twenty-head battery of Californian-type gravity-stamps, together with classified concentrating tables and a roasting furnace, was completed in the early part of 1941. Later in the year further underground development was suspended on account of the poor average values encountered. A small tin production was effected by primitive methods between May, 1942, and December, 1943.

Although the mineralisation on this property is fairly extensive and there are, in places, erratic pipe-like enrichments worked by Chinese, results on the whole were disappointing. It is evident that very carefully controlled selective mining methods would be necessary for any successful exploitation and then only on a comparatively small scale. The most important information proved by the diamond-drilling programme, however, was the existence of a third zone of mineralisation

at a depth well below any of the tunnelling developments. This zone could be correlated with an old surface lampau-working well above the level of the main surface workings and one of the tunnels was being directed to intersect it at an intermediate point. Unfortunately the detailed record of results obtained has been lost during the war period, but the significant feature remembered is that mineralisation in the diamond-drill hole occurred, admittedly mostly only as isolated stringers, but over a total width of 50 feet, one section of which assayed more than two per cent. tin over 30 inches, at a depth of some 600 feet below surface. In spite of the fact that average main-lode values proved disappointing there is no doubt that further exploratory work should be directed towards this third zone.

On the Ayer Hangat property lode-working has mainly been effected by open-cut quarrying. At the end of 1940 development here consisted of five diamond-drill holes, totalling 2,776 feet, together with 674 feet of underground tunnelling in ore and 327 feet in the granite country-rock. Total ore reserves developed at the same time amounted to 26,839 tons averaging 1.09 per cent. tin over an average width of 54 inches. Originally crude wire-rope haulage-ways had been used for transporting the ore to a primitive mill, consisting only of two water-wheels stamps for crushing and rough "palongs" for concentration and recovery of the tin-ore. A modern mill similar to that at Chagar was, however, in the course of construction in 1941, although this had not reached a sufficiently advanced stage of erection to allow of ore treatment.

142. *Chinchong Tin Mine*.—This mine, at Bukit Ulu Bakau, on the inter-State boundary between Pahang and Selangor, is also under the control of Straits Tinfields Limited. The annual figures of production during recent years are given below in pikuls of tin-ore:

1936.	1937.	1938.	1939.	1940.	1941-46.
1,359	1,286	795	462	313	Nil

A total of 2,240 feet of rock were cut by seven diamond-drill holes in the neighbourhood of the Chinchong quarry, where a sill of cassiterite-bearing quartz-topaz rock had been mined, prior to 1940, for nearly thirty years. Although the sill had been found to continue for some distance into the hill, work on it had been carried so far that the quarrying of the tin-bearing sill entailed the removal of a considerably higher proportion of barren overburden, consisting here mainly of partially decomposed biotite granite carrying large coreboulders. With a grade of ore said to average 0.45 per cent. tin over a sill thickness varying from 16 to 14 feet working costs proved excessive, so that operations were suspended at the end of 1940 pending reorganisation. Wire-rope haulage-ways provided transport to the mill, where crushing was effected by means of a five-head stamp-battery, followed by concentration over tables.

143. *Murai Tin Mine*.—The Sungei Murai opencast property of Murai Tin Limited, a subsidiary of Anglo-Oriental Limited, is situated only five miles from Bentong and was, in 1941, the largest producer of lode tin-ore in the district. It was worked originally as a lampau by Chinese miners from 1907, and was prospected and taken under the present management in 1917. Crushing proper did not commence until 1919, but since that date more than 50,000 pikuls of tin-ore have been won. Reports have been made by the Chinese tributor working this property since 1931 that small traces of gold have occasionally been seen on the concentrating tables.

In contradistinction to the occurrences previously mentioned, the cassiterite in this deposit occurs as very finely disseminated impregnations and in stockwork veinlets in friable, partly weathered, tourmalinised quartz-muscovite schist close to the granite contact. The average grade of ore mined during later years has varied between only 0.25 and 0.13 per cent. SnO_2 , although earlier it was said that certain rich

sections carried up to as much as eight per cent. Pyrite and arsenopyrite are present in small quantities and there are localised traces of copper minerals, evidenced by slight efflorescent hydrated copper oxide encrustations. Until the end of 1942 working of the deposit was effected by "glory-hole" quarrying: two faces more than 200 feet high had been formed, from which the ore was blasted and barred down. Thence it was trammed to the mill, being crushed in a ten-head stamp-battery and Huntingdon Mills, together capable of dealing with 8,000 tons of material per month. Concentration of the crushed product was effected by means of tables and buddles. The annual figures of production during recent years are given below in pikuls of tin ore:

1936.	1937.	1938.	1939.	1940.	1941.	1942.	1943-46.
2,201	2,944	1,336	1,675	2,380	682	391	Nil

Consequent on the decreasing tin values efforts were made to locate more remunerative ground and, towards the end of 1940, two diamond-drill holes were sunk into the working-face for distances of 117 feet and 142 feet respectively, but no improved values were encountered. This mine and mill had been worked on sub-lease tribute since 1931 and continued on a limited scale during 1942. It was taken over by a Japanese company in 1943, but no work was done.

144. *Alluvial Workings.*—As regards alluvial tin workings, "dulang-washing" has been, and in 1941 was still being, practised in many of the streams rising in the Main Range, more particularly in the Perting, Lebah, and Repas valleys. Lampan operations had been largely confined to these three valleys because this method, used in hilly country, inevitably leads to damage resulting from silting and flooding in the downstream areas unless effective tailings retention dams have been constructed and maintained. Only in these three valleys have such measures been taken and even so, unless a new scheme of retention is put into being, it is likely that all unrestricted lampan operations, for which the miners pay cess, will perforce have to be banned when the capacity of the present dams has been reached. Any such action would be extremely detrimental to future prospecting as, undoubtedly, large-scale hydraulic mining would be the best method of locating any new lodes in this area.

The alluvial flats below these dams, extending for a distance of nearly seven miles along the Bentong valley from above its confluence with the Sungei Repas to below where it is joined by the Sungei Benus, were worked by the first electrically-operated bucket-dredge to be installed in Malaya, in 1917. The depth of alluvium averaged 14 to 18 feet over a bedrock of phyllite and schist. The ground was worked out in 1939 after nearly 90,000 pikuls of tin ore had been won, but there is a possibility that other areas lower down the river, near Karak, may be worked in the future, as well as other smaller ones along the Sungei Kenong.

THE GEOLOGICAL SURVEY OF THAT PART OF SOUTH-WEST PAHANG COVERED BY TOPOGRAPHICAL SHEETS 3 B/16, 3 C/9 AND 3 C/13.

145. Apart from a preliminary examination of the workings in the Manchis tinfield, little else has been done in this part of south-west Pahang except for a few observations along the main roads.

146. *The Manchis Tinfield.*—The Manchis tinfield lies in the southern part of the Bentong district, a few miles to the east and north-east of Kampong Manchis. Production of tin-ore during recent years has been almost entirely from alluvial ground

in the Sungei Baris valley, south of the Ginting Tua, and from a tributary of the Sungei Pertang on the north side of the pass. The annual figures of production from this field during recent years are given below in pikuls of tin-ore:

			S.T.L.		Chan Hing.	Total.
1936	...	...	2,171	...	537	2,706
1937	...	...	2,588	...	505	3,088
1938	...	...	1,444	...	184	1,628
1939	...	...	1,688	...	445	2,133
1940	...	...	2,048	...	2,952	5,000
1941	...	...	2,129	...	3,623	5,752
1942	...	...	214	...	—	214
1943	...	...	36	...	—	36
1944-1946	...	...	Nil	...	Nil	Nil

The upper portion of the Baris valley, together with a small area to the north of the Ginting Tua, is under the control of Straits Tinfields Limited and was being intensively exploited by means of monitor-sluicing and utilisation of three 8-inch gravel-pumps, while the area to the north of these again was being worked with the aid of two 9-inch gravel pumps operated by the Chan Hing Kongsi. Whereas the Baris valley alluvium has a maximum thickness of only 25 feet (average 17 feet) overlying a bedrock of shales and phyllites, the Pertang tributary valley carries a considerably thicker bed of alluvium towards the north, as much as 60 and 70 feet, but is much more difficult to work on account of the bands of tenacious clay encountered before reaching the pinnacled limestone bedrock. Traces of old shaft-workings sunk into the alluvium in earlier days have been exposed in this locality by the operations of the Chan Hing Kongsi.

At a few places along the upper ends of the two valleys there is evidence of old lampan operations, while at two localities there have been attempts at prospecting in solid rock. At one point development of an opencast working has evidently provided, at one time, enough tin-ore to keep a ten-head stamp-battery in operation, but later prospecting work in 1939 to 1941, including diamond-drilling to the extent of 1838 feet and tunnelling for more than 250 feet, did not succeed in proving any payable ground. Examination has shown that the tin values occur, in the southern area, in narrow stanniferous quartz-veins carrying pyrite and arsenopyrite, usually from $\frac{1}{2}$ " to $\frac{3}{4}$ ", and rarely 2", in thickness. In one section certain layers of the folded shale series cut by these veins also indicate tin values. The stanniferous quartz veins trend east-southeasterly, but have been displaced by a later series of fractures trending slightly east of north.

An old vertical shaft sunk for 43 feet on the Ginting Tua divide had been cleared in 1941 exposing, though for a depth of 10 feet only, a number of flat-lying cassiterite-bearing sulphide-rich impregnated bands in indurated shales. This lode material, individual samples of which assayed up to as much as 6 per cent. tin, was composed of arsenopyrite, blende, cassiterite, fluorite, pale yellow garnets, monoclinic pyroxene, quartz, and tremolite, but further prospecting by open-cuts and winzes would be necessary in order to determine the extent and commercial value. A trial consignment of about 5 tons of this ore was put through the five-head stamp-battery and ball-mill then in operation, yielding the gratifying result of something like 2 per cent. tin concentrates. Undoubtedly, therefore, future prospecting should be directed initially to this locality. It is a significant feature that the old lampan workings, the opencast, and the shaft, all lie approximately along one common alignment. The fact that a boulder of grey medium to coarse-grained biotite-granite, partly porphyritic and with a slight fluxion arrangement of felspar phenocrysts, was seen near one of the gravel-pumps in the Baris valley, indicates that the granite contact cannot be very far distant from some of these workings: this will doubtless be confirmed by future detailed working.

A considerable quantity of tailings from the old mill, estimated to amount to 400,000 cubic yards, covers the alluvium in the upper portion of the Baris valley to a depth of 8 feet and still carries good values in tin (0.4 katty per cubic yard). In order to deal particularly with the fine tin under 150-mesh, of which these tailings carry a high proportion, the management had commenced, in 1941, the installation of a specially designed modern mill with classifiers and concentrating tables. The ground remaining after this retreatment was then to have been cleaned up by gravel-pump methods. As elsewhere all machinery was looted or destroyed due to the war, but a certain amount of lanchute working was carried out during 1942 and 1943. No further work has been done to date.

146A. *The Kemasul Wolfram Mine.*—A growing production on war-time demand for wolframite, iron-manganese tungstate, the chief ore of tungsten, is to be noted from the deposit opened up in the Kemasul Forest Reserve in the year 1937. Previous to this date only a small sporadic production had been recorded from the Sungei Ponson area, a few miles to the west of the Manchis tinfield, in the years between 1913 and 1918.

The Kemasul deposits occurs on a 111-acre mining lease situated on a tributary of the Sungei Pertang known as the Sungei Gaboi, a few miles to the north of the Manchis tinfield, and was being worked by gravel-pump methods. The annual figures of production are given below in pikuls of wolfram concentrates:

1937.	1938.	1939.	1940.	1941.	1942.	1943.	1944.	1945-46.
48	73	74	245	377	332	311	431	Nil

Production has not been restarted since the reoccupation.

REPORT ON SPECIAL INVESTIGATION OF COAL-BEARING FORMATION AT BUKIT ARANG IN THE STATE OF PERLIS DURING 1941 BY J. B. ALEXANDER, GEOLOGIST.

147. The area concerned is situated immediately adjacent to the Siamese border, to the south and west of the Bukit Arang trigonometrical boundary survey station, and is distant eight miles north-eastwards from the nearest road at Gua Nangka Estate. It is referred to in the unpublished report of 1913 by J. B. Scrivenor on the Economic Geology of Perlis; in the Geologist's Annual Reports for the years 1913, 1919, 1920, and 1921; in an article by E. S. Willbourn on "The Geology and Mining Industries of Kedah and Perlis", pp. 317-320, published in 1926; and in the textbook by J. B. Scrivenor on "The Geology of Malaya", pp. 117-118, published in 1931.

148. A special investigation of the coal-bearing formation in this locality was instigated in 1941 as a result of the 1913 report prepared for the Perlis Government by J. B. Scrivenor. At the time of this report seams exposed in shallow pits on the slopes of Bukit Arang and Bukit Tinggi (378 feet) had revealed small but valueless coal, although analysis showed that it was similar in quality to that being exploited in Selangor. From the percentage

of moisture contained it was classed as of Tertiary age, probably of the Miocene period. Scrivenor recommended that a drill-hole be put down to pierce the bottom of the Tertiary rocks in order to determine what coal-seams they contain. Some prospecting was done in the area in 1919, when two bores were sunk to depths of 81 feet and 65 feet respectively by a private firm under contract to the Federated Malay States Railways Department. Later, in 1921, a keystone drill was utilised for a third hole which ultimately reached 205 feet, but was abandoned at this depth owing to difficulties with running sands and financial shortage.

149. Operations in 1941, under the direct supervision of the Geological Survey Department, commenced with a preliminary rough traverse survey carried out during the month of June. This enabled certain recommendations to be formulated as to the most satisfactory method of tackling the whole investigation. It was decided that three deep drill-holes should be sunk to test the depth and nature of the Tertiary sequence, while shallow pits and or bores would be required in order to obtain detailed information as to the lateral extent and structure of these rocks. To this end three drill-sites were selected, a suitably central camp was built, and a rough access road was cleared through the jungle to connect the area with Gua Nangka Estate and allow necessary equipment to be brought in. Meanwhile nearly two square miles of the area were opened up by cutting a grid-pattern of traces at 500 feet intervals, involving compass-controlled clearing and pegging through thick undergrowth for a cumulative total distance of 40 miles. Detailed survey was subsequently carried along the cleared gridtraces and stream courses, clinometric observations being taken to enable the production of a fully contoured plan.

150. Arrangements were made with Messrs. Boyle Brothers to carry out the deep drilling part of the programme, but owing to very considerable difficulties and delays in moving the heavy equipment over the roughly-cleared jungle-tracks, for which purpose a lorry, handcarts, elephants, and porters were utilised at different times, it was early September before the keystone drill was ready to start the first hole in a position 1,500 feet due west of the Bukit Arang trig point. By the middle of October this drill had reached a depth of 342 feet, through variable bands of poorly consolidated clay, silt, sand, and gravel. It was then decided to use the smaller diamond-drill for deeper penetration. Considerable difficulties were experienced with running sands when artesian water was struck at a depth of 365 feet, so that it was early November before the hole reached 498 feet and not until early December that the final depth of 600 feet was attained. At this point the Japanese invasion of Malaya commenced and the entire equipment was abandoned when the area was evacuated. According to reports received since the reoccupation, all the machinery was subsequently looted and taken into Siam.

On account of wet weather and lack of good local labour, pitting was stopped at the end of October in favour of a programme for hand-boring to depths of 100 feet at suitable intervals over the area. Arrangements for this to be effected by a Chinese boring-contractor had been completed and should have been well under way by the end of 1941. A preliminary rough working plan over approximately 1½ square miles of the area had been prepared on a scale of 500 feet to the inch, but all copies of this, as well as the work progress charts, the geological section of the first drill-hole, and the compilation of detailed notes, have all been lost as a result of the Japanese occupation, and cannot be traced.

151. In the sequence cut by the drill-hole a total of eight distinct major bands of stiff chocolate-brown and light-grey clays were encountered, ranging in thickness from 26 feet down to 7 feet. Only fragmentary traces of coal were recorded at depths of 84-88 $\frac{1}{2}$; 130-132, 460-465, 475-480 and 490-495, while a definite two-inch band was noted just before reaching the final depth of 600 feet. All the cores from this hole had been retained and a complete series of sludge samples collected for subsequent quantitative sieve analysis, to be followed by heavy minerals separation and microscope examination. Samples of the tenaceous chocolate-brown clay from this hole, as well as of the light-grey clay from one of the shallow pits, were tested for refractory qualities by firing air-dried moulded test-pieces in the electric furnace at the Batu Gajah departmental laboratories. Good specimens of red tile and white porcelain resulted and it was considered that these clays might be of some commercial value. Accordingly, at the time of the Japanese invasion, test bulk-samples of the white-firing grey-clay had been collected from a depth of three to four feet in pit S500 W1500 ready for dispatch to certain interested commercial firms for subjection to fullscale works-tests.

CONCLUSIONS AND RECOMMENDATIONS.

152. Although no work had been done to determine their extent, it would appear that, included in the sequence there are a number of clay bands which may provide workable deposits of some commercial value.

Indications of exploitable coal, however, do not appear to be quite so promising as might have been hoped originally, for the following reasons:

- (a) no coal-seams of any consequence were encountered in the single drill-hole down to a depth of 600 feet, only fragmentary traces being recorded at six different horizons;
- (b) the nature of the strata penetrated was such as to indicate that, even had workable-sized coal-seams been found, considerable difficulties would be experienced with running ground during the course of any subsequent development.

153. The work done up to the time of the Japanese invasion was, however, still insufficient to give any clear idea of the economic potentialities of this area. The bottom of the Tertiary beds had still not been reached at a depth of 600 feet and no clue had been afforded as to the additional penetration necessary to achieve this object. In any case one deep hole alone would afford insufficient evidence on which to base a reliable idea of these beds. In order to give a satisfactory report it would be necessary to complete the comprehensive programme envisaged in 1941, involving three deep drill-holes, as well as a series of relatively shallow hand-bores at suitable intervals over the whole area for determining the lateral extent and structure of the formation.

PROGRESS REPORT OF GEOLOGICAL WORK IN PART
OF PAHANG NEAR KUANTAN BY FREDK. H. FITCH,
GEOLOGIST.

154. During April and May, 1941, a Japanese prospect for iron-ore in Ulu Sungei Rompin was examined, and a geological reconnaissance of Ulu Sungei Jeram, Anak Sungei Rompin, was made. A reconnaissance traverse of Sungei Keratong, in the same area, was made by a Malay rock collector. In June and July, 1941, an occurrence of bauxite near Sungei Endau was examined. Two months were devoted each year in 1940 and 1941 to continuous military training with the Federated Malay States Volunteer Force. A period of three weeks in 1940 was spent at the Head Office in Batu Gajah, Perak, at the annual conference of the Department. The remainder of 1940 and 1941 was devoted to detailed geological mapping of the area covered by topographical survey sheets 2 P/13, 3 D/1 and 3 D/5. Of this time, two months were spent in an underground investigation of the lodes and country in the mines of the Pahang Consolidated Company Limited at Sungei Lembing.

Detailed geological mapping was resumed in November, 1946, on topographical survey sheets 2 P/14, 3 D/1 and 3 D/2. Rocks exposed by recent roadwork on the coast road from Kuantan to Kuala Trengganu were examined in October, 1946.

THE AREA MAPPED ON TOPOGRAPHICAL SURVEY SHEETS
3 D/1, 3 D/2 AND 2 P/14 IN 1946.

155. Detailed mapping was extended to the northern edge of sheet 3 D/2 in November and December, 1946, and a little work done on sheets 3 D/1 and 2 P/14.

Sheet 3 D/2.—Basalt occurs throughout the group of small rubber estates east of Sungei Balok and in the southern half of Bukit Tanah Merah. Bukit Pengorok is composed entirely of granite, and this rock also underlies the northern half of Bukit Tanah Merah and the southeastern part of the Balok Forest Reserve. The high ground in the Forest Reserve, including Bukit Balok, is built of sedimentary rocks, principally quartzite. Micaceous slate, with a little interbedded quartzite, is exposed at Tanjong Gelang. A large part of Jabor Valley Estate is underlain by basalt.

Sheet 3 D/1.—Bukit Bangkong was found to consist of black and purple micaceous slate, with subordinate quartzite bands, dipping steeply to the west.

Sheet 2 P/14.—Cliff sections on Tanjong Cherating were examined in detail to determine the nature of the rocks of the Pahang Volcanic Series exposed in that area. The rocks are rhyolite ash, rhyolite agglomerate, and true rhyolite (the latter being uncommon), similar to those found in Bukit Rangan, near Kuantan. The bedding of the ash can be seen where erosion has affected the fine and coarse grained varieties to differing degrees.

THE AREA MAPPED ON TOPOGRAPHICAL SURVEY SHEETS
2 P/13, 3 D/1 AND 3 D/5, IN 1940 AND 1941.

156. The area mapped included parts of the catchments of the rivers Kenau, Terapai, Jin, Pohoi, Riau, Reman and Kuantan, and the Gambang Mining Field.

157. *The Principal Rock Types and their Distribution.*—Granite was intruded into sedimentary rocks, some of which, at least, are of Lower Carboniferous age. Subsequent

erosion has reached the tops of domes and ridges in the upper limit of the granite mass, so that now granite is exposed through breaks in the sedimentary cover. Such granite occupies an area of about 70 square miles north of Gambang. Between this and the granite ridge of Bukit Berkelah and Gunong Serudom, lies a narrow area of sedimentary rocks, along the eastern margin of which flows Sungei Pohoi. West of the lode mining district of Sungei Lembing, about six square miles of granite are exposed, but the central part of the roof of metamorphosed sedimentary rocks has not yet been eroded.

The sedimentary rocks in the area mapped include slates and quartzites, with restricted bands of quartzite conglomerate. Palaeontological evidence collected in 1939 showed that some of these beds are Lower Carboniferous in age, older than the limestone north of Panching, but insufficient further evidence has been obtained to state whether this applies to all. All these rocks had previously been considered to be of Triassic age, on account of their arenaceous nature, and were shown as such in published geological maps of Malaya.

158. *Geological History.*—The rocks of the whole area so far mapped in the Kuantan area have been provisionally grouped as follows, according to their relative ages, the youngest being mentioned first:

8. Alluvium.

7. Minor acid igneous intrusives.

There is clear evidence that quartz porphyry in the Bukit Ubi Quarry, near Kuantan is younger than the dolerite. Rocks, petrologically similar, were found in a number of places on Sungei Jarau, and on a tributary of Sungei Jin. In each case it was intrusive into slate and may be of the same age as that near Kuantan.

6. Dolerite and basalt.

Dolerite has been found in a number of places in the Pohoi valley, intrusive into granite. No case of dolerite intrusive into the granite west of Sungei Lembing has been noted, nor has it been satisfactorily proved cutting sedimentary rocks. The basalt near Kuantan has been described in the Annual Report for 1939 p. 26.

5. Minor acid igneous intrusives (late derivatives from 4.).

Where the time relationship of a minor acid intrusive to the dolerite cannot be seen, it is not possible to decide whether it belongs to this group or to group 7. It is probable, however, that most of the quartz-porphyrics, flow-banded felsites, quartz veins (including the lodes at Sungei Lembing), etc., seen cutting granite and sedimentary rocks, are late phases of the granitic activity, and are therefore to be included here.

4. Tin-bearing granite.

The granite exposed in the mines at Sungei Lembing is medium to coarse grained porphyritic biotite granite. Similar types, together with a little biotite granite porphyry, outcrop at the surface in the eastern part of the granite area near the mines. On Sungei Jin, still further west, where there is no mining, fine grained biotite granite and biotite granite porphyry are the commonest types, although medium to coarse grained biotite granite also occur. The mineralisation at Sungei Lembing thus appears to be associated with the normal medium to coarse grained porphyritic biotite granite and not with any specialised fine grained type. In the Gambang Mining Field, medium to coarse grained muscovite and biotite granites, sometimes porphyritic, are also common and fine grained granite is rare.

Two small outcrops of medium grained biotite granite were found in Sungei Taweh and another in one of its tributaries. A concentrate panned from the tributary contained cassiterite.

Molybdenite was found in pockets in light coloured granite on Sungei Singa, Anak Sungei Pohoi, associated with calcite and chlorite. This occurrence is small and of no immediate economic importance.

3. Slates and quartzites with subsidiary quartzite conglomerate.

This group of rocks which lie east of the limestone have been provisionally included here on the assumption that the general easterly dip, noted west of the limestone, continues to the sea; but this has yet to be confirmed in the field. Quartzite conglomerate has been found east of the limestone in eight places on and around Bukit Besi. In an outcrop on Sungei Taweh, it contains pebbles of blue vein quartz, slate, and quartzite, up to six inches long, and has been cut by veins of quartz carrying pyrite. A sample of this quartz gave 0.04 per cent. tin and no gold. On one of the tributaries of Sungei Ara, the matrix of the conglomerate is slaty instead of quartzitic.

2. Lower Carboniferous limestone.

A collection of fossils from Bukit Charas was described by Dr. Stanley Smith as of Visean age (see "Geology of Malaya", J.B. Scrivenor, 1931, p. 56). A few more fossils were obtained from this and other limestone hills but they were poorly preserved owing to the recrystallisation of the matrix. Bukit Panching, on Kuala Reman Estate, and three other limestone hills to the north, have been examined. Except for the presence of a small highly contorted lens of calcareous slate in Bukit Tenggek, no evidence of the structure of the hills was obtained, nor has sufficient work yet been done to establish the structural relationship between the limestone and the slates and quartzites to the east of it.

1. Lower Carboniferous slates and quartzites with subsidiary quartzite conglomerate.

Most of the argillaceous rocks are now slates and the arenaceous rocks quartzites, owing to the influence of heat and pressure associated with the intrusion of the granite. Some of the slates carry chistolite or andalusite and, in places, more intense metamorphism has produced mica schists and hornfelses. Quartzite conglomerate has been found in Sungei Tengging, a tributary of Sungei Keboh west of Sungei Lembing, as boulders associated with blocks of slate veined with quartz. White vein quartz constitute the bulk of the pebbles in the conglomerate.

159. *Erosion.—Lakes due to accumulations of landslide debris.*—An interesting feature of the Pohoi valley and of the area southwest of Sungei Lembing, is the presence of long narrow lakes at the mouths of many tributaries to the main rivers. They are shown to be of recent origin by the blackened trunks of large dead trees still standing in them, and although as much as half a mile long and a hundred yards wide, are quite shallow. The lakes were formed by the damming up of side streams by sand carried down by the main rivers from landslides on granite hills, mainly during the 1926 floods. The noise of landslides at that time on Bukit Berkelah was said to be clearly audible in Gambang, and something like one-third of the area of the hill is now deeply incised and bare of vegetation. If no further serious slips occur, the sand will be slowly moved downstream, the rivers will readjust themselves, and the lakes will disappear.

A similar lake was found on a tributary of Sungei Jin. The stream flows from a wide valley, through a narrow ravine, into the main river. Landslide debris, coming down the two sides of the ravine, has closed it, damming back the water to form a lake.

THE GAMBANG TIN MINING FIELD.

160. In 1911, there were 3,500 miners employed in tin mines near Gambang; the production was 23,000 pikuls of tin-ore, of which about half was smelted by Towkay Loke Yew in the village.

By 1917, however, many areas were thought to have been worked out and activity declined. Since that time, there have never been as many as 1,000 miners employed, and in 1939 there were only 159. In 1940-41, there was a considerable revival of interest and a number of gravel pump, lampan and opencast mines came into operation. In 1946 mining had not recommenced.

Cassiterite has been won from three types of ground, namely, alluvium, weathered granite and weathered slate and quartzite.

Gravel pumps, working in the valleys of Sungei Gambang and Sungei Badang, mined not only alluvium but also a few feet of weathered granite bed-rock, down to harder granite which could not be easily broken with monitors.

Lampan miners have stripped off the weathered granite from the slopes on both sides of many streams to a depth of ten feet or more. On Sungei Beruang, monitors were used by Beruang Limited for the same purpose.

A wide eluvial fan of slate and quartzite rubble lying against the eastern slopes of Bukit Sulai has been mined in the past.

At Sungei Kakura, there was a small opencast mine working weathered quartzite carrying disseminated cassiterite. A project to work on a large scale further downstream with mechanical excavators never came to fruition, although the area was opened up on a small scale by lampanning.

THE MINES OF THE PAHANG CONSOLIDATED COMPANY LIMITED AT SUNGEI LEMBING.

161. *Geological Setting.*—To the west of Sungei Lembang, a granite mass, about six square miles of which are exposed, is partly covered by a capping of metamorphosed sedimentary rocks, which lie more or less horizontal. North and east of the granite, the bulk of the sedimentary rocks dip to the east at an average angle of about 30 degrees. South of the granite, they dip south, at about the same angle, into the northern edge of the larger granite mass exposed north and west of Gambang.

162. *Fossils in Myah Mine.*—During 1940, the mines staff located two occurrences of fossils in Myah Mine. Collections from both these places were made, and one of them showed that the rocks were almost certainly deposited during Lower Carboniferous times.

The more important fossil locality is in section 79 V* on the 300 foot level. Here the fossils occur on the bedding planes of slate. They are not well preserved, having been partly replaced by pyrite which does not retain the detailed structure of the fossil and tends to break in an irregular manner when the fossil is being worked out. None the less, Dr. F. Elizabeth Alexander, of Singapore, was able to say that two of the three types of *Orthid* previously found at Sungei Terapai occurred in this collection, and that the *Punctospirifer* of the Terapai locality was probably also represented. A gastropod, some crinoid ossicles, and one fossil thought to have the appearance of a goniatite, were also collected, but these have unfortunately been lost during the Japanese occupation. It seems probable, however, that the Myah rocks are of the same age as the Terapai fossils, that is, Lower Carboniferous. (See Report of the Geological Survey Department for the year 1939, para. 61).

Other fossils were found in sections 89-90 N* on the 700 foot level and occur in a calcareous slate band about six inches thick with only a small lateral extent. The fossils are all crinoid ossicles and unlikely to be of value as indicators of the age of the enclosing rocks. Most are preserved in calcite but, in some cases, the calcite has been replaced by pyrite and sphalerite.

164. *Granite, as exposed underground.*—The granite, as seen underground more than fifty feet from its contact with slate, is the normal medium grained porphyritic biotite granite. Within fifty feet of the contact, it frequently contains less biotite and the phenocrysts of felspar are more abundant. Within a foot or two of the contact, the granite is very rich in phenocrysts, the majority of which lie parallel with the contact, biotite is rare. In places, between the granite and slate, there is a friable band of rock composed almost entirely of large flakes of white mica. There is no fine grained variety of the granite, such as is frequently seen at the edge of an igneous intrusion, where cooling and consequent crystallisation of the magma have been rapid, due to contact with relatively cool country.

164. *Structure of the Lodes.*—The lodes are mineralised tension fissures along which some lateral movement took place. Practically all this movement occurred before the lode channels were mineralised, brecciated ore being uncommon within the lodes. The amount of movement varied from one lode channel to another, being much less, for example, in Simons Lode than in Myah Main Lode.

In the case of Simons Lode, a band of a peculiar type of rhythmically banded shale (See Report of the Geological Survey Department for the year 1939, para. 62) has been only slightly displaced by movement along the lode channel. In some parts of Simons Lode, the walls are lined with a thin layer of chloritic clay gouge from which vein quartz crystals have grown inwards, the space between the inner terminations of the crystals being partly filled with sulphide minerals cassiterite, and chlorite. This is the "comby structure" of some of the Cornish tin lodes and indicates the infilling of an open cavity or a fissure under tension. More massive vein quartz occurs irregularly, in some places in rapidly pinching lenses parallel with the lode, and in others occupying spaces between blocks of unshered country, at right angles to the general trend of the lode.

Common structural characteristics of the lodes are:

- (a) The presence of a variable amount of gouged and brecciated country.
- (b) Irregularity of width.
- (c) Frequent division both vertically and laterally, with barren country between the branches.
- (d) More or less vertical dip.
- (e) Lodes in Willinks, Kabang and Myah Mines cross the strike of the country. 16 out of 35 lodes, including those of Willinks and Kabang Mines, bear east and west. 11 of the remainder, including those in Willinks East Mine, trend 120 degrees east of north.

165. *Zone of Mineralisation.*—In Willinks Mine, the contact between the granite and slate dips towards the east from its exposure at the surface. A zone of mineralisation in the slate dips east from the surface parallel with this contact. In Willinks East Mine, the lodes are most strongly developed in the lower levels and no granite has been exposed, even in the deepest workings. Still farther east, in Kabang and Myah Mines, granite is exposed in the lower levels and the lodes again outcrop at the surface. Thus this zone of mineralisation rises and falls with the height of the subterranean surface of the granite mass. Payable tin lodes are therefore unlikely to occur in sedimentary country more than a mile or so from an exposed contact with granite. Some prospecting should, however, be done in more distant areas as lodes may occur associated with unexposed rises of the subterranean granite surface, as in Myah Mine.

166. *Willinks Fault*.—A fault, striking 55° east of north, average dip 60° to the north-west, separates Willinks and Willinks East Mines. This fault has given rise to a zone of gouge and breccia varying in width up to almost 200 feet. There are no recognisable sedimentary horizons from which the amount of movement can be determined, nor are there slickensides with a constant direction to show the relative amounts of horizontal and vertical movement. The apparent lateral displacement of the main zone of lode channels at the fault is about 200 feet to the south-west on the south-east side of the fault, measured along the fault plane. This probably represents the horizontal component of movement on the fault and it is believed that the vertical movement was relatively unimportant.

Slickensided and gouged fragments of ore occur in the fault, between the two dislocated parts of the zone of lode channels, in sufficient quantity to make some parts of the broken fault material payable to work. A number of small mineralised quartz stringers lie parallel with the fault and many are unbrecciated. Close to the fault, the widening and multiplication of the lodes are probably due to the tearing open by drag of tension fissures, making the passage of the mineralising agent easier than in fissures farther from the fault. The apparent ability of Willinks Fault to affect the extent of mineralisation suggests that movement along the fault began during or before the mineralisation itself. It seems probable that movement ceased before the close of mineralisation since there are unbrecciated mineralised quartz stringers parallel with the fault.

THE FUTURE OF TIN MINING IN A PART OF PAHANG, NEAR
KUANTAN, COVERED BY TOPOGRAPHICAL SURVEY SHEETS
3 D/1 AND PARTS OF 3 D/5 AND 2 P/13.

167. The future of the Pahang Consolidated Company Limited is assured for many years. Although the mines were found to be flooded to the 180 foot level when the staff returned after the Japanese occupation, and the pumping equipment and other machinery had been largely destroyed, the amount of proved ore reserves before the war, the amount of undeveloped ore in known lodes, and the indubitable presence of further lodes to be revealed by underground prospecting, justify the expenditure necessary to rehabilitate the mines. The possibilities of the Ulu Reman and Ulu Bukah areas, from which a considerable amount of alluvial tin has been won already, have also not been fully tested.

168. The prospects of the Gambang Mining Field are not so encouraging. There is no doubt that it is past its heyday. In 1940, the increased demand for tin resulted in the opening of two new gravel pump mines, bringing the total in the district up to six, but neither of the new mines showed signs of becoming a large concern. The ground they worked was shallow, and in one case the alluvium had been cemented by secondary minerals to form a mass broken only with difficulty by the monitors. The four older mines were having to strip a considerable thickness of old tailings before reaching new tin-bearing ground. As long ago as 1909, it was stated that the Gambang Field was worked out, and yet mining survived there until the Japanese occupation. It would therefore be unwise to predict that it cannot be revived but, at the same time, it would appear necessary to attempt to locate mineable areas a little farther afield.

169. A long narrow strip of sedimentary rocks occupies the valley of Sungei Pohoi, the granite north of Gambang lying east of it, and that of Bukit Berkolah and Gunong Serudom to the west. Concentrates panned from the bed of Sungei Pohoi, above Kuala Sungei Singa, were rich in cassiterite. Prospecting of flat areas in this valley would stand a good chance of success.

170. Farther north, in the valley of Sungei Taweh, there are three small outcrops of granite, not previously recorded, and cassiterite occurs in the bed of the stream flowing over the most northerly one. A sample of mineralised quartzite conglomerate in this valley carried 0.04 per cent. tin. The flat area of alluvium a mile or so downstream might well repay prospecting.

THE MANUFACTURE OF BRICKS NEAR KUANTAN.

171. Before the Japanese occupation, bricks were made from white to yellow tenacious alluvial clay in four brickworks near Kuantan. The proportion of sand to clay was variable; at one place the clay was so nearly homogeneous that it was simply taken from pits, without puddling, moulded and baked. At the three other factories, water buffaloes were made to trample round and round in circular pits partly filled with water, to puddle the clay and sand into a uniform product. According to tests said to have been made on one property, there was sufficient suitable clay to last for many years.

Bricks, drain-pipes, and tiles were all moulded by hand, one man being able to mould 800 bricks in a day. The bricks were dried in the air for about ten days and then baked for six to ten days in large ovens, fueled with rubber tree wood. The ovens at the four factories held 80,000, 70,000, 100,000, and 80,000 bricks respectively. Filling an oven, baking its contents, and emptying the oven again took about 22 days.

The prices charged in 1940 were: bricks \$15 per thousand, tiles \$6 per thousand, and drain-pipes 6 cts. each. Local demand was sufficient to keep all four factories fully occupied. In 1946 they were all derelict.

GOLD MINING ON SUNGEI LUIT.

172. In 1940, about 80 dulang washers were panning gold on Sungei Luit, a tributary of Sungei Pahang which crosses the Kuantan-Jerantut road at about the 114th milestone from Kuala Lipis. Their workings extended over about four miles of the river above a point three miles upstream of the road. Prospecting had also revealed an alluvial area which was selected for mining lease.

The gold won by the dulang washers in the lower reaches of the river was well rounded, but that won farther upstream was distinctly angular. In one place, blocks of mixed sulphides (pyrite, galena, and chalcopyrite) occur in the bed of the river. A sample from one of these blocks gave traces of gold and 80.4 dwts. of silver per ton. Farther upstream, a vein of similar material is exposed *in situ* in the east bank of the river. The single sample taken from the blocks in the river is not adequate for an appraisal of the value of veins in this area. Prospectors should pay some attention to the hills as well as the rivers, and when alluvial gold is being worked, an attempt should be made to locate the source of the gold and test whether it can be worked economically as a lode proposition.

IRON-ORE IN ULU SUNGEI ROMPIN.

173. A deposit of iron-ore was prospected in Ulu Sungei Rompin during the years 1936-1941 by the Ishihara Sangyo Koshi, a Japanese mining company which was working iron-ore in other parts of Malaya and shipping it to Japan for smelting. A geological examination of the deposit was made in April-May, 1941, after all Japanese personnel had been withdrawn.

174. Iron-ore in workable quantities occurs in the following hills: Bukit Ibam (by far the most important), Bukit Sanam, Bukit Pesagi, Bukit Sanlong, and the eastern ridge of Bukit Angen. Bukit Hitam and Bukit Robo were also prospected but gave disappointing results. All these hills, except Bukit Hitam, lie between Sungei Jeram and its tributary Sungei Tepisoh. Available ore is probably in the order of 80 million tons, much of it containing between 50 and 60 per cent. of iron.

Prospecting.—The district was first examined in 1932. Later it was prospected under Pekan Boring Permits Nos. 7/36, 1/37 and 2/39. Where boulder ore occurred, two sets of *rentices* at right angles, from two to five chains apart, were cut. Pits were sunk at the intersections, to bedrock wherever possible. Where the exposures of iron-ore warranted it, adits were driven into the hills at various levels.

Available Ore.—The principal deposit is undoubtedly that on Bukit Ibam where ore outcrops as a discontinuous wall up to 100 feet thick, protruding as much as 30 to 40 feet from the ground, and having an aggregate length of about 30 chains. Boulders shed from this outcrop occur on both sides of the hill.

The prospectors gave the following figures of available ore :

	Tons.
Bukit Ibam—Outcrop and boulder ore ...	5,000,000
<i>In situ</i> ore	8,700,000
Bukit Sanam	500,000
Bukit Sanlong	700,000
Bukit Pesagi and Bukit Angen	4,500,000
Bukit Hitam	600,000
	<hr/> 20,000,000
"Hidden reserves"	10,000,000
Total	<hr/> 30,000,000

The estimate for *in situ* ore on Bukit Ibam was roughly checked on the spot and appeared reasonable. The inclusion of "hidden reserves" amounting to half the proved reserves may have been optimistic, but the above figures indicate the approximate size of the deposits.

Results of the analyses of samples from Bukit Ibam and Bukit Sanlong have been grouped by localities and averaged to give the following figures :

Locality.	Number of samples.	Fe %.	SiO ₂ %.	Mn. %.	Fe 100%.	
					P %.	Cu %.
Bukit Ibam Adits ..	10 ..	60 ..	6 ..	0.52 ..	0.06 ..	0.10
Pits	22 ..	54 ..	18 ..	0.38 ..	0.12 ..	0.09
Bukit Sanlong Pits ..	29 ..	54 ..	14 ..	0.21 ..	0.09 ..	0.02

The highest iron percentage recorded from these two hills was 68.76 per cent. for a sample from an adit on Bukit Ibam. A sample from a pit on the same hill gave 28.7 per cent. manganese. The sulphur content of samples from Bukit Ibam pits ranged up to 0.084 per cent.

Rock Types in the District.—On Sungei Jeram, shales, slates, and quartzites, with a dominant reddish-purple colour, are exposed. A number of boulders in Sungei Mungas, probably derived from the eastern slopes of Bukit Sembilan, are chloritic muscovite-quartz hornfels, formed by the thermal metamorphism of rocks similar to those exposed on Sungei Jeram.

Granite, exceptionally rich in epidote, was cut by an adit on Bukit Ibam. Medium grained biotite granite, with some epidote and chlorite, forms boulders in Sungei Mungas. Quartz-diorite in Sungei Ragin carries biotite and colourless to purple pyroxene. Biotite microgranite is exposed in the same river. Epidote-rich granite occurs in Sungei Jeram, between Kuala Sungei Mago and Kuala Sungei Chipai. Weathered boulders of granite are scattered over the low ground east of Bukit Sanam.

The rock which forms the actual walls of the iron-ore veins is difficult to determine as it is everywhere sheared and weathered. However, it seems to be similar to that exposed in Sungei Mungas, Sungei Ibam, and Sungei Ragin, namely, quartz-porphyry, some of it flow-banded. Some of the specimens from Bukit Ibam, although highly weathered and so not determinable with certainty, suggested volcanic tuffs.

Geological Structure of the District.—The outcrop of quartz-porphyry is elongated north and south; the rock is sheared in the same direction, shear planes dipping steeply and, in places, carrying quartz stringers. The sedimentary rocks of Sungei Jeram have the same strike but dip only gently to east or west.

The granite has only just been reached by erosion and the outcrops are small. In contrast with the severely sheared quartz-porphyry, the granite is unsheared. The shearing of the quartz-porphyry was probably due to earth movements associated with the emplacement of the granite, the latter being the younger rock. The flow-banding and tuffaceous appearance of some specimens suggest that the quartz-porphyry may be a member of the pre-granitic Pahang Volcanic Series.

Minerals in the Iron Ore.—Hæmatite and magnetite, in varying proportions, form the bulk of the ore. Magnetite occasionally occurs alone and appears to be more abundant near the granite; apparently pure hæmatite is mildly attracted to the bar magnet when crushed and probably contains some finely disseminated magnetite. The hæmatite is mostly in the massive form, although there is some specularite (micaceous hæmatite). In places, hæmatite which has partly replaced sheared country forms small globules along bands following the shearing. Pyrite occurs rarely with the oxides.

Limonite has been formed extensively in the weathered zone by the hydration of the primary oxides. Other hydrated oxides such as goëthite may also be present. Limonite is coated by insignificant quantities of malachite in a pit on the outcrop of the ore on Bukit Ibam. Secondary black manganese minerals are associated with limonite in the dump at one of the adits on the same hill.

Tin-ore is associated with iron ore in some parts of Malaya, but tests made by the Geological Survey Department on 41 samples submitted by the prospectors failed to reveal any tin.

Very few specimens contain any visible gangue. Very pale green chlorite, in radiating flakes and fibres, filled the spaces between iron minerals in one piece of ore collected, while another contained white to blue gibbsite, exhibiting botryoidal structure. A few of the poorer quality specimens contained a fine mosaic of quartz which probably represented the last remnants of largely replaced quartz-porphyry. Vein quartz is not common in the ore.

Bauxite.—A layer of bauxite, one to one and a half feet thick, underlies the boulder ore on Bukit Sanam. The aluminium content is about 50 per cent. but the silica and iron contents are both high.

Geological Structure and Origin of the Ore Bodies.—The iron ore bodies are a series of lenses and pockets with more or less north-south elongation, parallel with the regional strike and shearing. They have generally been more resistant than the country and so occur on the crests of a series of roughly parallel ridges.

The almost complete absence of specimens showing partial replacement of country by ore suggests that replacement played only a small part in the formation of the ore bodies. It appears that a body of quartz-porphyry was sheared and then invaded by epidote granite, rich in iron. The iron became concentrated in migrant solutions which deposited their load in the overlying quartz-porphyry, in locations governed by the shearing, to form hematite-magnetite veins. Since the granite is seen to be unshattered, it is probable that the veins do not pass down into it; an adit which passed through granite in the northern end of Bukit Ibam failed to cut ore.

Transport.—The prospect is 40 miles from Kuala Sungei Rompin, in a direct line, and 100 miles by river. The river is very winding, subject to wide fluctuations of level, narrow and fast-flowing in places, wide and shallow in others. Even a large *prahu* is sometimes unable to reach Pasir Aur after a spell of dry weather. When the river rises during the northeast monsoon, the sea is usually so rough that the loading of ore from lighters into ocean-going ships, which would be unable to approach nearer than six miles from the coast, would be difficult. It was estimated by the prospecting company that 140 tugs and 400 *tongkangs* would be needed to carry a sufficient output of ore to the coast; these would, at best, provide a slow and uncertain means of transport.

The Ishihara Sangyo Koshi therefore investigated the possibility of building a railway, although much of the country between the prospect and the sea is very swampy. After five trial surveys, a route to the sea at Kuala Sungei Rompin was chosen. It was estimated that, using timber from the jungle and stone from the hills on the route, it would take three years to build, at a cost of about three and a half million dollars.

Future Investigation.—The chief difficulty in the way of the successful commercial exploitation of the deposits is the cost of transport of the ore to a place where it can be smelted. If this difficulty can be overcome and any future investigation of the deposit is made, the prospector should bear in mind the possibility of using a magnetometer survey instead of the laborious and costly underground methods for which there is no suitable labour locally. Strong magnetic anomalies have been observed: an ordinary prismatic compass points almost south on some of the hills.

BAUXITE NEAR SUNGEI KEMBAR, ANAK SUNGEI ENDAU. PAHANG.

175. Bauxite of commercial grade occurs on Bukit Gennum, south of Sungei Kembar, Anak Sungei Endau, and poor quality bauxite on Bukit Barnang, west of Bukit Gennum. The district, apart from these two hills cultivated by the local Sakai, is flat and swampy.

Transport.—Large *tongkangs* have been used on Sungei Endau for the transport of iron-ore. They could reach Kuala Sungei Kembar at all states of the tide, and probably go some way up Sungei Kembar itself at high tide.

Bukit Gennum.—Fragments and boulders of bauxite occur sparsely on the crest of the hill and at its northern end. On the south and south-east sides of the hill, an almost continuous outcrop of bauxite about 30 yards in length and protruding about three feet from the soil, was sampled. A small pit below the outcrop yielded bauxite of poor quality.

The following analyses were made and although the iron content is rather high, some of the bauxite may be payable. No quantitative estimate of the ore can be made without systematic pitting. The hill itself is only about 200 yards long and 100 yards wide, rising only about 40 feet from the surrounding swamp:

	15830.	15831.	15832.	15833.	15836.	A.
SiO ₂ ..	0.92 ..	28.05 ..	1.70 ..	1.60 ..	1.92 ..	6.52
Al ₂ O ₃ ..	56.65 ..	34.53 ..	57.18 ..	58.66 ..	60.42 ..	54.57
Fe ₂ O ₃ ..	10.21 ..	8.77 ..	9.42 ..	8.14 ..	6.38 ..	9.12
TiO ₂ ..	1.20 ..	1.90 ..	1.40 ..	1.20 ..	1.20 ..	0.25
H ₂ O ..	31.10 ..	27.07 ..	30.74 ..	30.80 ..	30.40 ..	29.20
Total ..	100.08 ..	100.32 ..	100.44 ..	100.40 ..	100.32 ..	99.66

15830 Bauxite concretions in soil, west end of Bukit Gennum.

15831 Worm casts, west end of Bukit Gennum.

15832 From bauxite outcrop, south-east end of Bukit Gennum.

15833 Bauxite block in soil, east end of Bukit Gennum.

15836 Bauxite from pit below outcrop on Bukit Gennum.

A Composition of bauxite mined at Kim Kim (near Johore Bharu) as given by Sir Lewis L. Fermor in "Report on the Mining Industry of Malaya", 1939.

Bukit Barnang.—Bauxite concretions from the soil and from a pit on the hill gave loss on ignition varying from 11.9 per cent. to 16.6 per cent. As these results indicate poor quality, complete analyses were not made.

KUANTAN TO KUALA TRENGGANU ROAD.

176. Exposures made by recent road work on the road from Kuantan to Kuala Trengganu were examined in October, 1946. The rocks found all corresponded with those already shown on the 1938 Geological Map of Malaya, scale 12 miles to an inch. A report that the Japanese had quarried limestone at Kampong Kuala Abang, just north of Dungun, during the occupation, for use in smelting iron, was proved to be incorrect; the only material in any way resembling limestone in that quarry was white vein quartz.

CHEMICAL LABORATORY.

177. Mr. Harral reports as follows on the work done in the chemical laboratory. The laboratory was not functioning until Mr. Tooke's return in May, therefore this report only covers the last seven months of 1946 except for a few determinations done previously by the Senior Laboratory Assistant—Mr. Leong Pak Cheong—at the Institute for Medical Research Laboratories in Kuala Lumpur.

The Japanese removed practically all chemical reagents and essential apparatus from the Department, so at first analytical work was rather difficult and will continue to be so until all the new equipment arrives from England. The amount of chemical work will naturally increase as the mining industry is rehabilitated and geological work progresses.

Eighty five samples were examined for Government and the Public compared to 916 in the year 1940.

For the General Public.—The majority of the 21 tin assays were carried out on amang samples. Interest is being shown in the by-products of tin recovery; two samples of monazite being analysed for thorium oxide content and a zircon concentrate for its zirconium oxide. Eight samples of refractory materials were received for identification which entailed a partial analysis in each case. In 1939, 426 and in 1940, 57 gold assays were done but only one sample was received in 1946 for gold, silver and lead content.

For the Mines Department.—Five tin assays were required and 2 samples of tin concentrates were examined for their arsenic percentage. A series of 16 bauxite were analysed for 5 constituents. In previous years many river waters have been examined for suspended matter; no doubt this work will again be required when many of the Chinese mines reopen. Six samples of aluminium, 1 bronze and 2 tin alloys were analysed to determine their composition.

Other Government Departments.—One sample was received from the Customs Department for assay of tin. Telecommunications required the analysis of a Japanese solder. For the Railways, 2 limestones were submitted for partial analyses and for the Police Department, 6 amangs for identification.

Departmental.—In previous years 20 or more complete analyses of silicate rocks necessitating the determinations of 16 or more constituents have been done for the Geologists annually. Essential apparatus for this type of work has not yet arrived from England. For 1946 only 3 tin, 3 gold assays and a few miscellaneous determinations were carried out.

Thanks are due to several commercial firms and to other Government Laboratories for the loan and gift of apparatus and chemicals which were required from time to time to enable this Laboratory to handle the work enumerated above.

BATU GAJAH,
21st February, 1947.

F. T. INGHAM,
Director, Geological Survey,
Malayan Union.

REF ID: A66383

MINES DEPARTMENT, FEDERATION OF MALAYA
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Annual Report
on the
MINING INDUSTRY
FOR THE YEAR
1948

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A. BEAN, A.C.S.M., M.I.M.M.,
Chief Inspector of Mines, Federation of Malaya.

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ANNUAL REPORT ON THE ADMINISTRATION
OF THE MINES DEPARTMENT AND OF THE
MINING INDUSTRY OF THE FEDERATION
OF MALAYA FOR 1948.

PART I.

INTRODUCTION.

1. INTRODUCTION.—The formidable task of rehabilitation with which the Mining Industry was faced in 1946 and onwards has been continued during the year and progress made is reviewed in this report.

Throughout this report references to "tin-ore" are to be construed as referring to concentrates of tin-oxide as submitted to smelters for further treatment; "tin-in-ore" refers to the calculated tin metal content of such concentrates. During pre-war years, this was based upon an average tin assay value of 75.5 per cent.; for the period of the Japanese "occupation" 1942-1945 upon an average tin assay value of 72 per cent; for 1946 upon an average tin assay value of 74 per cent.; and for the years 1947 and 1948 upon an average tin assay of 75 per cent. The variation in assay value was due to the relative efficiencies of concentration and cleaning of the concentrates during the periods referred to.

It will be noted that figures for tin-ore concentrate production are given in "piculs", and those for tin metal contents are given in "tons" (of 2,240 lbs). For ease in conversion the systems of weights and currency in local use in relation to the standard British systems are given below:

Weights—

1 tahl = 10 chee = 100 hoon.

= $1\frac{1}{3}$ ozs. avoird. = 1.215 ozs. Troy.

16 tahils = 1 katti = $1\frac{1}{3}$ lbs.

100 kattis = 1 picul = 133 $\frac{1}{3}$ lbs.

16.8 piculs = 1 ton (2,240 lbs).

Currency—

1 Straits dollar (\$1) = 100 Straits cents.

= 2s. 4d. sterling.

2. SHORT HISTORY OF TIN MINING IN MALAYA.—In post-war years a short historical and geological sketch has been embodied in the Annual Reports, but it is now considered more appropriate that such history should be embodied in the quinquennial reports.

The yearly progressive development in production can be ascertained by a study of the statistics in this report, which reveal the deplorable condition of the Industry when the country was liberated in 1945, and the commendable efforts made in order to reach the present production stage.

3. DISTURBANCES AND THE EMERGENCY.—Since May of this year when the Emergency period can be considered to have started, considerable interference with the Mining Industry has been caused, particularly to prospecting activities, which have been virtually closed down owing to terrorism.

During the early part of the year labour was unreasonably belligerent and unco-operative, and there were strikes on several mines. Shortly before the outbreak of violence, which really initiated the "Emergency", the Communist agitators started to avoid public appearances, since which time there have been no further strikes and the Mining Industry has been unusually free from labour trouble.

Subsequent to June, 1948, a number of attacks have been made on mines and some damage has been done, but little effect has been made on production. In some cases machinery on mines has been destroyed, but generally speaking this has been repaired and brought into production again, and at the end of the year there were very few mines out of production on account of terrorist activity. By far the most serious aspect of the Emergency has been the attacks made on mine personnel. The terrorists have, unfortunately, become increasingly active in staging ambushes, and mine staffs have in several cases suffered casualties from this cause. On Chinese mines particularly both staffs and labour have been intimidated, and loss of efficiency has resulted. A few mines have ceased rehabilitation, and on others in remote areas rehabilitation has been postponed.

The position would probably have been far more serious had it not been for the timely inauguration of the Chinese Mines Defence Scheme in Perak. Under this scheme during the period 28th August, 1948, to 15th October, 1948, some 152 Police Posts were built on Chinese mines in Perak and manned by 1,526 Special Constables. Although the Special Constables have suffered casualties they have taken their toll of the enemy, and the fact that only a few mines have suffered damage to plant and equipment since they have been defended under this scheme is sufficient proof of its value. This scheme was ably organised and carried out by Mr. O. D. Paterson, an Officer of this Department, who was released specially for the purpose, notwithstanding the severe shortage of staff.

The biggest outrage happened at Malayan Collieries, Batu Arang, Selangor, in July, when a well organised and armed band of terrorists virtually had control of the property for about one and half hours. Five Chinese employed on the mine were killed; three excavators, eight earth-moving vehicles and three electric motors were damaged, and a considerable quantity of explosives were stolen. Fortunately this damage had little effect on production and no consumers of coal were affected.

The major effect of the terrorism is the decrease in supervision. Europeans live under perpetual tension and are overworked; Chinese owners visit their mines only at infrequent and irregular intervals. The inevitable consequence is a loss in efficiency, which is not less real because the loss of production and effect on development cannot be assessed. The disturbances have had a considerable effect on the Mining Industry, but mines have continued to open, and production to increase, but at a somewhat slower rate than would otherwise have been the case. Great credit is due to the miners for their pertinacity, and to the field staff of all branches of the Mines Department, who have continued with their normal visits to mines and rubber estates.

PART II.

PROSPECTING AND LAND ALIENATION.

4. A constitutional change took place in February when the Federation of Malaya replaced the Malayan Union. Under the constitution, the entire property in, and control of State land, is vested solely in the Ruler of the State, who may issue Prospecting Licences and Prospecting Permits, lease State land for mining purposes for such periods and on such terms as he may desire.

PROSPECTING.—Due to the war and the restricted land policy in force during 1946 and the greater part of 1947, which was necessitated owing to the loss of records, etc., occasioned by the occupation period, there has been little prospecting done since 1941, although, as will be seen from the statistics, mining has been carried on throughout those years. Thus the reserves of mining land have been severely depleted and little replenishment has been possible.

Further, since May of this year little prospecting has been done, owing to terrorist activity rendering such operations unsafe. Until terrorist gangs have been exterminated prospecting activities will be more or less at a standstill. This will have a very serious effect on mines, whose reserves of workable ground are (a) nearing exhaustion, or (b) consist of ground containing poor tin-ore values which are barely economical to work. Unless reserves can be obtained by such mines it is probable that they will be forced to stop working.

Unless more land is made available for mining in the not too distant future, and the security situation improves to the extent that prospecting can be carried on without lives being endangered, mineral production in this country will decrease, which will result in a reduction in revenue and the number of persons employed in mining. This would seriously affect the general economy of the country, and is a situation which is alarming to contemplate.

With the reconstruction of State Regional Planning Committees, it is to be hoped, that more land will be made available for mining and so ensure the future prosperity of the Industry, which has, and is still an important factor in the economy and recovery of Malaya. The Industry is, by far, the biggest single revenue producer, per acre of land affected, a point which is greatly in its favour. While some of the objections to mining are probably sound, others are the results of prejudices which have existed for many years. With the advancement in mining methods prejudicial views should willingly be open to revision in the light of technical progress.

Research should be commenced on the resuscitation of worked-out mining land with a view to its being used for other industrial (i.e., agricultural and forestry) purposes. Further experiment is also required on the use of mining effluent (slimes) in the irrigation of padi. Though experiments carried out by the Agricultural Department pre-war have shown that mining effluent with limited solid matter can be used without harmful effects on the growth of rice, it is necessary to make further experiments so as to ascertain what is the maximum solid matter per gallon that mining effluent may contain before it becomes harmful to rice growing.

An area in the Central Mental Hospital Reserve at Tanjong Rambutan was prospected departmentally, and as a result it was recommended that a part of the area should be reserved for mining purposes.

The Eastern Coastal Belt was re-opened to mining applications during the year, and it is hoped that further interest will be shown in mining in that area after the Emergency is over. With the gradual exhaustion of the older mining fields interest will turn to these areas, which have been little explored and where there may be more scope.

(a) *Prospecting Licences and Permits.*—Details of the number of prospecting licences and permits issued in 1948 and the areas affected thereby are given in Table 1:

TABLE 1.

Prospecting Licences and Prospecting Permits.

States.	No. of applications in 1948.	No. of licences or permits issued in 1948.	No. of former licences and permits current on 1st Jan., 1948.	Total acreage under licences and permits.	Total acreage selected for mining leases.	Percentage selected to area held under permit.
Perak ..	262	37	15	8,504	737	Per cent.
Selangor ..	141	15	7	9,112	197	8.6
Negri Sembilan ..	29	9	4	4,694	108	2.0
Pahang ..	84	31	15	229,833	600	2.3
Johore ..	31	24	12	158,936	4,075	0.3
Trengganu ..	46	18	10	11,726	—	2.5
Kedah ..	25	4	3	2,719	—	—
Perlis ..	1	—	1	63	—	—
Kelantan ..	—	—	—	—	—	—
Malacca ..	5	1	2	3,996	—	—
Totals ..	621	139	69	429,873	5,715	1.33
1947 ..	478	82	19	209,679	949	0.45

(b) *Forest Permits.*—Details of licences and permits to prospect in Forest Reserves during the year and the areas affected thereby are given in Table 2:

TABLE 2.

Forest Permits.

States.	No. of applications in 1948.	No. of permits issued in 1948.	No. of former permits current on 1st Jan., 1948.	Total acreage under permits.	Total acreage selected for mining leases.	Percentage selected to area held under permit.
Perak ..	59	—	1	600	—	Per cent.
Selangor ..	20	7	5	11,819	80	0.68
Negri Sembilan ..	5	—	—	—	—	—
Pahang ..	5	3	—	12,927	—	—
Johore ..	4	3	—	882	140	16.82
Trengganu ..	2	1	—	1,696	43	10.40
Kedah ..	14	3	—	—	—	—
Perlis ..	—	—	—	—	—	—
Kelantan ..	—	—	—	—	—	—
Malacca ..	—	—	—	—	—	—
Totals ..	109	17	6	28,324	263	0.93
1947 ..	89	10	3	20,734	1,695	8.18

(c) *Applications in Respect of Other Areas (Rubber Estates, etc.).*—Details of areas affected by prospecting in 1948 under section 48, Cap. 147 (under this section it is necessary to obtain the permission of the proprietors to prospect land other than mining land) are given in Table 3 below:

TABLE 3.
*Notices to Prospect Agricultural Areas under Section 48
of Mining Enactment.*

States.	No. of new notices in 1948.	No of areas notified previously and prospect- ed in 1948.	Total acreage prospected in 1948.	Total acreage selected for mining leases.	Percentage, selected to prospected.
					Per cent.
Perak	52	11	11,032	808	7.0
Selangor	35	5	4,816	134	2.8
Negri Sembilan	7	1	76	—	—
Pahang	—	—	—	—	—
Johore	22	—	72,305	—	—
Trengganu	} Not applicable				
Kedah					
Perlis					
Kelantan	—	—	—	—	—
Malacca	4	—	1	—	—
Totals ..	120	17	88,230	942	1.07
1947 ..	51	2	7,834	224	2.86

(d) *Summarised Results of Prospecting, 1948.*—Prospecting work under the 368 permits valid in 1948 has not been fully completed in respect of each permit, but by the end of the year sufficient work had been done to enable applications for mining leases covering 6,920 acres to be made.

(e) *Prospecting Records.*—Prior to the war each State and District Mines Office kept a library of prospecting results, but due to the war some of these records were lost and the library is now being gradually restored. Pre-war all those prospecting results that were not confidential were available for public inspection, and the mining community found these a great source of help in their search for reserves. Copies of all prospecting results received are submitted to the Geological Survey Department by this Department for their records, and to-day both the Geological and Mines Departments have libraries of prospecting results.

5. LAND ALIENATION.—Details of land alienated for mining purposes as at the close of the year are given in Tables 4 and 5 which classify the land according to States and mineral to be mined.

TABLE 4.
Area of Mining Land, by States.

States.	Total acreage excluding concessions at 31st Dec., 1947.	Total acreage of concessions at 31st Dec., 1947.	1948.			Total acreage including concessions at 31st Dec., 1948.
			Acreage newly alienated.	Acreage formerly under other titles.	Acreage cancelled.	
Perak ..	140,771	—	4,895	609	6,952	139,323
Selangor ..	55,059	—	285	1,723	983	56,084
N. Sembilan ..	11,238	—	714	—	1,267	10,685
Pahang ..	83,841	182,400	436	—	590	216,087
Johore ..	14,123	—	528	—	1,178	18,475
Trengganu ..	35,337	60,000	—	—	391	94,946
Kedah ..	6,324	—	—	—	1,010	4,314
Perlis ..	2,584	—	80	—	115	2,649
Kelantan ..	1,172	—	—	—	—	1,172
Malacca ..	310	—	10	43	86	277
Totals ..	299,759	242,400	6,948	2,375	12,570	538,912

TABLE 5.
Area of Mining Land, by Minerals.

Mineral.	Total acreage excluding concessions at 31st Dec., 1947.	Total acreage of concessions at 31st Dec., 1947.	1948.			Total acreage including concessions at 31st Dec., 1948.
			Acreage newly alienated.	Acreage formerly under other titles.	Acreage cancelled.	
Tin-ore ..	230,461	107,400	6,670	2,375	10,804	426,012
Gold ..	21,879	—	198	—	340	21,737
Wolfram ..	13,276	45,000	—	—	159	58,117
Fluorite ..	13,104	—	—	—	—	13,104
China clay ..	123	—	—	—	52	71
Coal ..	8,467	—	—	—	—	8,467
Iron ..	4,406	—	—	—	—	4,406
Manganese ..	—	—	—	—	—	—
Graphite ..	135	—	—	—	—	135
Not specified ..	7,908	—	80	—	1,126	6,863
Totals ..	299,759	242,400	6,948	2,375	12,570	538,912

From Table 6B it can be seen that only a small amount of land has been made available for mining compared with the total acreage of the country. Much of that land has been mined for many years and is now fast approaching the stage when it can no longer be worked.

TABLE 6A.
*Yearly Federal Comparative Statement in Acres of Forest
Reserves and Mining Land.*

Year.	Total area.	Area covered by Forest Reserves.	Percentage of Forest to total area.	Area alienated for mining.	Percentage of Mining to total area.
	Acres.	Acres.	Per cent.	Acres.	Per cent.
1946 ..	32,281,600	6,923,136	21.446	561,485	1.739
1947 ..	32,281,600	6,923,320	21.462	542,159	1.679
1948 ..	32,179,200	7,194,560	22.353	538,912	1.675

TABLE 6B.

FEDERATION OF MALAYA.

Comparative Statement in Acres of Forest Reserves and Mining Land for Year Ending 31st December, 1948.

State.	Total area.	Area covered by Forest Reserves.	Percentage of Forest to total area.	Area alienated for mining.	Percentage of Mining to total area.
	Acres.	Acres.	Per cent.	Acres.	Per cent.
Perak	5,107,200	1,896,896	37.142	139,323	2.728
Selangor	2,022,400	537,792	26.592	56,084	2.773
Negri Sembilan	1,651,200	691,520	41.880	10,685	0.647
Pahang	8,844,800	1,775,168	20.070	216,087	2.443
Malacca	409,600	40,768	9.953	277	0.068
Trengganu	3,232,000	142,720	4.416	94,946	2.938
Kedah	2,342,400	692,500	29.577	4,314	0.184
Johore	4,691,200	903,232	19.254	13,475	0.287
Perlis	198,400	32,512	16.388	2,549	1.285
Kelantan	3,680,000	481,152	13.075	1,172	0.032
Total	32,179,200	7,194,560	22.358	538,912	1.675

PART III.

SUMMARY OF MINING AND PRODUCTION, 1948.

6. TIN-ORE—(a) *Occurrence*.—Cassiterite (SnO_2) is the principal mineral mined and is found in deposits of primary and secondary origin. The types of deposits found are:

- | | | |
|-------------------------------|-------|--------------|
| (i) Pipes .. .. | .. .. | } Primary, |
| (ii) Veins or stringers .. .. | .. .. |  |
| (iii) Detrital .. .. | .. .. |  |
| | | } Secondary. |

Most of the production of tin-ore, past and present, has been obtained from detrital deposits, which have been formed as a result of the erosion of pipes, veins or stringers. The detrital deposits consist of beds comprising gravels, grits, sands and clays, and the distribution of these beds has been affected by fluctuations in sea-level, and by solution of the bedrock underlying them.

The main tin producing areas in Malaya are:

State of Perak—Kroh, Taiping, Sungai Siput, Kinta Valley (including Ipoh, Batu Gajah and Kampar), Tronoh, Temoh, Chenderiang and Bidor;

State of Selangor—Rawang and district, Kuala Lumpur and district;

State of Negri Sembilan—Titi, Rantau, Mantin and Seremban district;

State of Pahang—Sungai Lembing, Gambang, Bentong and Manoh;

State of Trengganu—Kemaman;

State of Johore—Kota Tinggi district.

The Kinta Valley, Perak, has been the largest and richest alluvial tin area in the country, if not in the world, and it is estimated that about 45 per cent. of the country's past production has been derived from this zone.

The Pahang Consolidated Company has worked tin bearing lodes in their concession in Pahang since 1906, and has been one of the world's largest individual producers.

(b) *Mining Methods Used.*—The methods employed during the year under review can be divided into the following categories:

- (i) Dredging (Bucket type);
- (ii) Gravel Pump Mining;
- (iii) Hydraulicizing;
- (iv) Open-cast Mining;
- (v) Lode Mining;
- (vi) Lampanning;
- (vii) Dulang Washing or Panning.

A brief description of these methods was given in the 1947 Annual Report, and it is now intended to give descriptions of mining methods only in quinquennial reports.

(c) *International Tin Control.*—A short history of Tin Restriction has been compiled, and it now forms part of this report at Appendix I.

(d) *International Tin Study Group.*—Three Group meetings were held during the year, at which the Group reviewed the world tin position and agreed to recommend to member-Governments the setting up of a working party to examine the appropriateness and practicability of framing an inter-Governmental agreement on tin conforming to the general spirit and principles of the charter of the International Trade Organisation.

A Secretariat has been established at the Hague, Holland, which publishes a Statistical Bulletin of world production, exports, imports, stocks, etc.

(e) *International Tin Research and Development Council.*—This body directs research into the development and extension of the uses of tin, its research laboratories being situated in England. The finances of this body are principally maintained by contributions from the producing countries in the world. The contribution from Malaya is obtained by means of a cess imposed on tin-in-ore exported, which is at present four cents per picul of tin-in-ore.

(f) *Mining Activities.*—In reviewing the progress made in rehabilitation of the Industry it is necessary to summarise the status of the Industry as it was in 1941—restriction was then in force, but the International quota release was 130 per cent. The figures quoted for 1941 cover the four principal tin producing States which comprise the former Federated Malay States, namely, Perak, Selangor, Pahang and Negri Sembilan. Detailed figures for the other States are not available.

(i) A classification of the average 1941 monthly production is given in Table 7.

TABLE 7.

Analysis of 1941 Average Monthly Production.

From Dredges	3,493	tons tin-in-ore	..	50.9%	of total
From Gravel Pump Mines	2,411	" "	..	38.0%	"
From Hydraulic Mines	251	" "	..	3.8%	"
From Opencast Mines	263	" "	..	3.9%	"
From Underground Mines	252	" "	..	3.8%	"
From Dulang Pass Sales	103	" "	..	1.5%	"
From Other Sources	6	" "	..	0.1%	"
Total	6,699	tons tin-in-ore.			
From European Mines	4,732	tons tin-in-ore	..	70.6%	of total
From Chinese Mines	1,857	" "	..	27.7%	"
From Other Sources	110	" "	..	1.7%	"
Total	6,699	tons tin-in-ore.			

This brief statistical summary indicates the magnitude of the rehabilitation task with which the Administration and Industry were confronted. At the time of the liberation in 1945 the Industry was at a standstill; practically all mines were flooded, and mechanical equipment rendered immobile where it had not been totally ruined. Essential supplies and material were not available and law and order had not yet been established.

(ii) It was during the closing months of 1945 and immediately after the liberation that Mr. A. D. Storke, was sent out to Malaya by the Secretary of State for the Colonies, to report on the position and the problems confronting rehabilitation.

Storke Report.—The position as outlined by this report may be summarised briefly as follows:

(i) Dredges were placed into four categories according to their condition, the estimated time by which replacements could be obtained, and the units sufficiently rehabilitated to resume restricted production operations, as—

Category "A"—41 dredges, viz., those requiring machinery and equipment in quick supply and which, it was thought, could be expected to re-start production by August, 1946;

Category "B"—46 dredges, viz., those requiring replacements considered to be available within about one year and which could probably re-start production by July, 1947;

Category "C"—17 dredges, viz., those requiring salvage work in the field before inventories of replacements could be made but which could probably re-start production by January, 1948; and

Category "D"—22 dredges, viz., those in such a condition as to be of only salvage or scrap value.

From this summary, it is seen that, of the 126 dredging units operating, stopped, under construction or dismantled in Malaya pre-Japanese war, it was considered that 104 could be repaired, while 22 must be written off as having no further operating value.

(ii) Gravel Pump Mines mostly Chinese-owned, were classified into three categories, according to dewatering and supply conditions, as—

Category "A"—71 mines, viz., those which could be expected to be in a position to re-commence production by August, 1946;

Category "B"—193 mines, viz., those which could be expected to be in a position to re-commence production by June, 1947; and

Category "C"—219 mines, viz., those which could be expected to be in a position to re-commence production by January, 1948; in addition, there were approximately 150 other mines, the future of which was uncertain for reasons such as inadequacy of land holding, depleted reserves, and the like;

(iii) Other mining methods were similarly briefly analysed;

(iv) The overall estimates of rehabilitation and progressive production of the Industry, as reflected by the Storke Report, may be summarised as follows:

TABLE 8.

Storke's Estimated Progress of Production Tons, Tin-in-Ore.

Year.	SOURCE OF PRODUCTION.						Total.
	Dredges.	Gravel pump mines.	Open cast mines.	Lode mines.	Dulang washing.	Other sources.	
1946 ..	5,000	3,200	600	—	1,500	2,000	12,300
1947 ..	25,250	9,800	2,000	1,000	1,200	6,000	46,150
1948 ..	39,800	17,000	3,100	2,700	1,200	9,000	72,800
1949 ..	40,500	17,000	3,100	2,700	1,200	9,000	73,500

(iii) *Rehabilitation Progress.*—The progress made in rehabilitating the Industry in 1948 as shown by statistics and against the estimates of the Storke Report is shown in Appendix II, and Graph I (which also shows the progress of rehabilitation since January, 1946).

It will be seen from Appendix III and Graph II which has been compiled on a similar basis to Table 8 to illustrate progress, and for purposes of comparison with Storke's estimated progress of production, that the progress made up to December, 1948, had still not come up to the expectations of the Storke Report.

The nearest approach to fulfilment of the projected figures was in gravel pump mines, which produced 16,254 tons (364,085 piculs) tin-in-ore against Storke's estimate of 17,000 tons, that is 95 per cent. of Storke's estimate. Graph II shows progress in production since January, 1946.

The dredge production estimates for 1949 in Table 8 must of necessity be modified considerably in the light of progress achieved and the prospects for rehabilitation during the coming year.

The overall dredge position at 31st December, 1948, was as follows:

Units in active production	...	...	...	67
Units in process of rehabilitating	...	...	...	13
Not yet being rehabilitated	...	...	...	13

Although the Storke Report has been analysed and referred to in detail, it must be appreciated that the programme anticipated in the report was merely an estimative guide, in the compilation of which unpredictable factors (such as the availability of labour and supplies), could not be assessed. The survey was carried out with speed and the report prepared at a time when full and detailed inspection of the various units was not possible; when all the difficulties encountered are taken into consideration, its predictions have been reasonably sound. It has been a most useful guide and was most creditably close to the mark when appreciation is given to the uncertainty and conditions obtaining at the time of the Japanese capitulation in 1945 and in manufacturing countries, particularly the United Kingdom, immediately post-war. Considering the difficulties which have arisen, the actual progress has, in many respects, been remarkably good.

Progress in the rehabilitation of the Industry during the year has been retarded by many difficulties, the main being:

- (i) unsettled labour conditions;
- (ii) slowness of the arrival of equipment ordered from overseas;
- (iii) shortage of mining land;
- (iv) high cost of labour and materials;
- (v) incidence of terrorism and the "Emergency".

The unsettled labour conditions and "Emergency" are dealt with in Parts I para. 3 and V para. 23 of this report.

During 1948 the arrival of equipment from overseas has been speeded up considerably, in comparison with the year 1947, but there is still much difficulty in obtaining deliveries of electrical and certain other items of equipment. Steel plates are still in short supply in the Federation, although there appear to be better supplies in Singapore.

Some mines have at present inadequate reserves of workable ground to warrant rehabilitation, and until further tin-bearing areas can be found for them, rehabilitation of such properties will not commence, or will be on a much smaller scale of working than previously. The shortage of land available for mining is dealt with in Part II para. 4 of this report.

On reference to Tables 9 and 10 it will be seen that progress has been considerable, but to bring the Industry back to its 1941 status there is still much to be done. The "Emergency" which started in May of this year has definitely retarded rehabilitation, but to what degree it is difficult to say. A number of dredges which are to be dismantled and moved from worked out areas to new areas cannot be moved as the new areas are situated in localities which are considered to be unsafe.

An inspection of Table 11 (a) and (b) will show that the monthly production of tin-ore increased throughout the year. Estimated production (which was conservative) was not reached, although had rehabilitation proceeded at anticipated speed the estimated production would easily have been obtained. The effects of the "Emergency" are more likely to be felt in the ensuing years.

Table 29 shows the amount of labour employed monthly during the year by the various methods of mining.

TABLE 9.

*No. of Tin Mines (not units) Producing at the end of 1941
(September), 1946, 1947 and 1948.*

Year.	Dredg- ing prop- erties.	Gravel pumping (inches).	Hydrau- licing.	Open- cast.	Miscel- laneous.	Small workings without machinery.	Total.
1941 (Sep.) ..	74	668	31	17	10	133	933
1946 (Dec.) ..	21	102	23	1	6	66	219
1947 (Dec.) ..	46	323	24	10	27	48	478
1948 (Dec.) ..	48	464	22	8	33	39	614
Month.							
January ..	43	339	23	10	22	43	480
February ..	44	344	23	9	22	46	489
March ..	44	356	22	9	25	45	501
April ..	44	363	23	10	22	47	509
May ..	45	372	22	10	25	47	521
June ..	43	393	21	10	29	46	542
July ..	47	412	22	8	30	41	558
August ..	47	430	23	6	33	39	578
September ..	48	436	23	7	32	42	588
October ..	48	447	22	7	32	42	598
November ..	48	462	20	7	35	41	613
December ..	48	464	22	8	33	39	614

TABLE 10.

*No. of Units operating in Tin Mines Producing on
31st December, 1948.*

State.	Dredg- ing.	Gravel pump- ing.	Hydrau- licing.	Open- cast.	Under- ground.	Miscel- laneous.	Total.
1941 ..	103	668	31	17	10	133	962
1947 ..	56	323	24	10	27	48	488
1948—							
Perak ..	39	322	18	—	4	26	409
Selangor ..	22	101	1	2	—	1	127
Negeri Sembilan ..	4	14	—	1	—	—	20
Pahang ..	—	8	—	—	1	4	13
Johore ..	1	10	2	—	—	—	13
Trengganu ..	—	1	—	—	3	2	6
Kedah ..	1	4	—	4	—	—	9
Perlis ..	—	1	1	1	25	—	28
Kelantan ..	—	—	—	—	—	—	—
Malacca ..	—	8	—	—	—	5	13
Totals ..	67	464	22	8	33	39	633

TABLE 11 (a).

Monthly Production in Piculs of Tin-Ore by Methods of Mining during 1948.

Month.	Dredg- ing.	Gravel pump- ing.	Hydrau- licing.	Open- cast.	Under- ground.	Dulang washers.	Miscel- laneous.	Total.
January ..	37,663	26,666	3,883	1,266	1,965	3,868	419	75,735
February ..	34,512	22,655	3,770	1,159	1,541	3,175	427	67,239
March ..	39,825	27,097	4,200	532	1,798	3,601	365	77,418
April ..	39,746	27,593	4,380	927	1,972	3,361	316	78,800
May ..	41,972	30,093	4,239	1,301	1,864	4,265	435	84,194
June ..	37,279	30,775	4,093	637	2,193	4,070	371	80,003
July ..	42,817	31,926	4,086	1,006	2,117	4,432	252	86,636
August ..	44,007	33,382	3,830	876	2,112	4,534	305	89,046
September ..	40,844	32,381	3,896	1,059	2,572	5,020	488	86,260
October ..	44,263	31,944	4,006	992	2,632	6,440	491	89,358
November ..	44,295	33,969	3,927	1,344	3,193	5,659	632	93,019
December ..	44,088	35,594	4,745	1,453	3,492	5,527	702	95,606
Totals ..	491,311	364,085	49,090	12,557	27,471	54,052	5,303	1,003,869

TABLE 11 (b).

State Production in Piculs of Tin-Ore by Methods of Mining during 1948.

States.	Dredg- ing.	Gravel pump- ing.	Hydrau- licing.	Open- cast.	Under- ground. (a)	Miscel- laneous. (c)	Total.	Dulang passes. (b)
Perak ..	321,338	245,272	48,579	—	1,575	4,513	621,277	37,022
Selangor ..	139,292	93,050	202	9,744	—	73	242,361	15,137
N. Sembilan ..	16,690	11,365	101	14	—	230	28,450	979
Pahang ..	—	5,133	—	—	18,509	303	23,050	228
Johore ..	8,166	2,124	101	—	—	—	10,391	225
Trengganu ..	—	4,217	—	15	1,974	82	6,288	—
Kedah ..	5,825	816	—	1,293	—	—	7,930	461
Perlis ..	—	91	107	83	5,413	—	5,694	—
Kelantan ..	—	—	—	—	—	52	3,467	—
Malacca ..	—	2,012	—	1,403	—	—	—	—
Totals ..	491,311	364,085	49,090	12,557	27,471	5,303	940,817	54,052

(a) Includes cave workings. (b) All ore washed is included here irrespective of the race of the washers. (c) Also includes concentrates from treatment of amang produced by dredges, gravel pumps, etc.

For production under methods of mining in long tons tin-in-ore see Appendix III.

TABLE 12.

Production of Tin-Ore in Piculs from European and Chinese Mines during 1948.

States.	European mines.		Chinese mines.		Dulang washing.		Total.
	Produc- tion.	Per- centage of total.	Produc- tion.	Per- centage of total.	Produc- tion.	Per- centage of total.	
Perak ..	384,453	58.4	236,819	36.0	37,022	5.6	658,299
Selangor ..	149,362	58.0	93,009	36.1	15,137	5.9	257,498
Negri Sembilan ..	16,690	56.7	11,700	40.0	979	3.3	29,429
Pahang ..	18,697	77.3	5,253	21.7	228	1.0	24,178
Johore ..	8,166	76.9	2,225	21.0	225	2.1	10,616
Trengganu ..	—	—	6,288	100.0	—	—	6,288
Kedah ..	5,825	69.3	2,114	25.2	461	5.5	8,400
Perlis ..	—	—	5,694	100.0	—	—	5,694
Kelantan ..	—	—	—	—	—	—	—
Malacca ..	—	—	3,467	100.0	—	—	3,467
Totals ..	583,188	58.1	366,629	36.5	54,052	5.4	1,003,869

Appendix IX shows tabulated statistics relating to the European section of the tin mining industry, and Appendix X shows similar statistics for the Chinese section of the industry.

(iv) *Dulang Washing*.—This is a method of recovery rather than of mining, and consists of washing tin bearing ground in a dulang or pan. If it is desired to win tin-ore by this method, a pass must be obtained from the Mines Department, the fee for which is \$1. They are only issued to women.

TABLE 13.
Number of Dulang Passes and Monthly Production by States.
(In Piculs tin-ore).
1948.

Month.	Perak.	Selangor.	Negeri Sembilan.	Pahang.	Johore.	Trengganu.	Kedah.	Perlis.	Kelantan.	Malacca.	Total production.
No. of dulang passes.	13,910	5,225	520	270	147	—	200	—	—	—	Total passes. 20,281
January	2,645	998	116	36	43	—	27	—	—	—	3,868
February	2,252	782	85	30	13	—	32	—	—	—	3,175
March	2,548	897	82	15	24	—	35	—	—	—	3,601
April	2,651	1,032	100	20	12	—	46	—	—	—	3,861
May	2,900	1,147	100	24	9	—	45	—	—	—	4,265
June	3,148	1,389	91	13	5	—	24	—	—	—	4,670
July	2,798	1,522	69	13	13	—	17	—	—	—	4,432
August	2,923	1,503	71	10	12	—	15	—	—	—	4,534
September	3,316	1,535	80	13	21	—	56	—	—	—	5,020
October	3,727	1,541	74	13	35	—	50	—	—	—	5,440
November	4,119	1,346	61	18	17	—	58	—	—	—	5,659
December	3,993	1,365	69	23	21	—	56	—	—	—	5,527
Totals	37,022	15,137	970	226	225	—	461	—	—	—	54,052

(g) *Malaya and World Production*.—Appendices IV and V show the world's production—consumption and stocks. This is of interest as it shows Malaya's position as a producing country.

(h) *Tin Production, Employment and Revenue*.—From Appendix VI it will be noted that the revenue in the form of duty from tin has fluctuated considerably during the period indicated, the worst years being 1930-34 inclusive. During those years there was restriction of output, with the result that many mines only operated spasmodically throughout that period, depending on the quota release. Labour was also affected; mines only operated part-time, and a considerable number of labourers were discharged, as will be seen from column (d) Appendix VI.

The Mining Industry spends large sums of money on local purchases, which in turn give employment to a considerable number of people in foundries/factories, shops and elsewhere. The prosperity of the country in the past has been largely due to the revenue from tin.

(i) *Price of Tin-ore and Tin (Metal)*.—(i) *Tin-ore*.—The nett price is that actually received by the miner from the local tin-ore buyer or the Smelting companies, and is calculated on the local market price of tin and the assay value of the ore, deductions being made for Cess for tin research, export duty, weighing fees, smelting charges and geographical charges which include freight, insurance, cost of bagging, etc.

Table 14 gives the nett prices offered during 1948.

TABLE 14.

Local Price of Tin-Ore, 1948.

(On the basis of 75 per cent. tin content).

January-31st March, 1948, average nett ore price...	\$160.53
1st April-6th April, 1948, average nett ore price ...	160.53
7th April-31st May, 1948, average nett ore price ...	160.28
June-December, 1948, average nett ore price ...	175.95
Average nett ore price for the year ...	\$170.99

(ii) *Tin (Metal)*.—By agreement the price of tin was fixed by the United Kingdom Ministry of Supply throughout the year, and is shown in Table 15.

TABLE 15.

Price of Tin, 1948.

Period.	London.	Local. Straits Dollar Average.
January ...	£500.0.0	\$253.12
February ...	500.0.0	253.12
March ...	500.0.0	253.12
April 1st-6th ...	500.0.0	253.12
„ 7th-30th ...	504.0.0	255.14
May ...	504.0.0	255.24
June ...	554.0.0	280.77
July ...	554.0.0	281.23
August ...	554.0.0	281.45
September ...	554.0.0	281.17
October ...	554.0.0	280.96
November ...	554.0.0	280.77
December ...	554.0.0	280.77

The slight variations in the dollar price were due to variations in the Banks' buying rate. The price reached \$282.02 for a short period at the end of July and beginning of August, 1948.

(j) *Export Duty on Tin-ore*.—For many years tin-ore exported to places other than Singapore, Penang, United Kingdom or Australia was subjected to an additional export duty of \$30 per picul, but in accordance with the charter of the International Trade Organization this additional duty was removed on the 30th June, 1948.

(See para. 43 for export duties for all minerals).

(k) *Costs of Mining—Dredging*.—Owing to the short periods worked by some dredges, and to various factors connected with rehabilitation generally, a definite figure for average costs would be misleading. A reasonable approximation for normal working is about 25-35 cents per cubic yard.

Gravel Pumping.—As in the case of dredging average costs are difficult to obtain during a period of rehabilitation, and, in addition, the Chinese system of accounting as generally used takes little notice of the difference between capital and working

costs, and amortization of capital is rarely practised. The most reasonable estimate of approximate average cost is \$125 to \$135 per picul of tin-ore. Generally mining costs have risen since the end of 1947.

7. BAUXITE.—Bauxite is the principal mineral of aluminium used for the extraction of the metal. There has not been an intensive search in this country for bauxite, but deposits have been found in the State of Johore and the Settlement of Malacca. Pre-war two mines were operated by the Japanese in Johore, but these are to all intents and purposes worked out. Although there has not been any active mining during 1948 exploration work has been conducted with favourable results, and it is anticipated that in the not too distant future mining for this mineral will be re-started and production will be on a scale much larger than pre-war.

Table 16 gives figures of production and export from the inception of bauxite mining in Malaya.

TABLE 16.
Production and Exports of Bauxite.
(Long Tons).

Year.	Production.			Total Exports.
	Johore.	Malacca.	Total.	
1936 ...	36	—	36	36
1937 ...	19,000	—	19,000	12,628
1938 ...	55,081	—	55,081	55,751
1939 ...	92,256	—	92,256	84,387
1940 ...	62,779	—	62,779	?
1941 ...	50,824	—	50,824	?
1942)				
1943 ...	225,450	170,000	395,450	253,450
1944)				
1945 ...	—	—	—	—
1946 ...	—	—	—	—
1947 ...	—	—	—	—
1948 ...	—	—	—	—
Total ...	505,426	170,000	675,426	406,252

TABLE 17.
Typical Analyses of Johore Bauxite Mined Prior to 1942.

Name of Mines.	ANALYSIS.				
	Al ² 3%	Fe ² 3%	Si ² 2%	Ti ² 2%	Ignition loss %.
Bukit Pasir Mines, Batu Pahat ...	57-58	6-7	3-5	0.9-1.0	
Sri Medan Bauxite Mines, Batu Pahat ...	55-59	2.6-8	3-6	About 1.0	
Sungei Kim Kim Mines, Kota Tinggi District...	54-57	9-12	5-8	0.25	28.50 Moisture loss at 100°C., 0.70

8. COAL.—The only coal mine in the Federation of Malaya is situated at Batu Arang, Selangor, and is owned by the Malayan Collieries Ltd., where coal is won from both opencast and underground mines.

(a) *Methods of Mining*—(i) *Opencast*—Where the coal outcrops it is quarried in opencast mines, the overlying shale being first blasted and then moved by dragline excavators either into various vehicles for disposal or else dumped direct where it will not interfere with future operations. The maximum thickness of shale stripped so far is about 120 feet, but it is hoped that it will prove economical to take up to 200/250 feet. The coal in the opencasts is mined partly by hand and partly by excavators, and is now all transported by belt-conveyors. Opencast mines have been worked around the perimeters of both seams. The size of these workings increased with the introduction of large excavating equipment, and prior to the war the main opencast unit was producing some 40,000 tons a month. Since the liberation the opencast workings have provided the bulk of the output, whilst underground units are again being developed, and it is expected that as these come into large scale production the need for opencast mining will correspondingly decrease, except as standby to meet emergencies or peak demands. Over the life of the Colliery about equal quantities of coal have been won from opencast and underground workings.

(ii) *Underground*.—The coal has been won underground in eleven mines at various times, of which six were operating at the time of the Japanese invasion. Subsequently all were flooded, but two have been reopened for development as the main production units. The upper seam has been followed down the dip at one place for about 3,000 feet from the outcrop and the lower seam for about 3,700 feet.

In the early days of the mine most of the coal was won by miners using picks with handles about five feet long, although coal cutters and conveyors were used in the years before the war. The method of mining was longwall in three "lifts" or layers with hydraulic stowing to give the maximum recovery. It is now intended to mechanise all underground operations as far as possible, and coal-cutters, loaders and conveyors are in operation with the object of evolving a method which will enable a high percentage of the coal to be extracted with the minimum risk from spontaneous combustion and other hazards. Coal cutters and belt-conveyors are in regular use and "Joy" and "Duckbill" loaders are being tried, but neither the system of working nor the machinery to be employed have yet been settled. Past experience in the old hand-working methods is out of date since mechanisation is nowadays essential.

The Collieries have met the consumers' demands during the year. Some of the 1941 consumers have changed over to fuel oil, hence the demands on the Collieries are not so great as pre-war. During 1948 the price was unchanged at \$20.50 per ton f.o.r. Batu Arang.

TABLE 18.

(b) Yearly Production of Coal.

Year.	Tons.	Value.	Remarks.
		\$	
1930 ...	567,166 ...	3,272,121 ...	—
1931 ...	401,172 ...	2,317,064 ...	—
1932 ...	282,860 ...	1,588,398 ...	—
1933 ...	218,246 ...	1,208,250 ...	—
1934 ...	321,860 ...	1,548,127 ...	—
1935 ...	392,153 ...	1,914,022 ...	—
1936 ...	520,750 ...	2,594,179 ...	—
1937 ...	628,948 ...	3,320,909 ...	—
1938 ...	477,908 ...	3,226,947 ...	—
1939 ...	441,025 ...	2,431,073 ...	—
1940 ...	781,509 ...	5,841,778 ...	—
1941 ...	687,000 ...	5,527,000 ...	—
1942 ...	244,590 ...	—	... Japanese occupation
1943 ...	489,442 ...	—	.. ..
1944 ...	409,100 ...	—	.. ..
1945 ...	{ 202,900 ...	—	.. ..
	{ 23,802 ...	—	... Sept.-Dec., 1945
1946 ...	224,674 ...	3,707,121 ...	—
1947 ...	226,301 ...	4,176,368 ...	—
1948 ...	375,460 ...	7,696,930 ...	—

TABLE 19.

Monthly Production of Coal in 1948.

Month.	Tons.	Value.
		\$
January ...	31,364 ...	642,962
February ...	24,742 ...	507,211
March ...	31,914 ...	654,237
April ...	26,956 ...	552,598
May ...	30,431 ...	623,836
June ...	34,753 ...	712,437
July ...	31,379 ...	643,269
August ...	33,521 ...	687,180
September ...	31,534 ...	646,447
October ...	34,904 ...	715,532
November ...	31,098 ...	637,509
December ...	32,864 ...	673,712
Total ...	375,460 ...	7,696,930

The following is a general analysis of Batu Arang coal:

Moisture	...	...	...	...	21 per cent.
Volatile matter	...	...	...	...	35 „
Fixed carbon	...	...	...	...	35 „
Ash	...	...	...	...	9 „
Calorific value as received	...	...	...	...	9,000 B.T.U.
Calorific value on dry basis	...	...	...	...	11,390 „
Calorific value on dry ash free basis	...	...	...	...	12,850 „

9. GOLD.—(a) The principal gold producing centre in Malaya is the Raub district of Pahang, and the only large producer is the Raub Australian Gold Mining Co., Ltd., who have operated for many years. The progress of rehabilitation of the mine has been retarded, due to similar difficulties as confronted the tin mines. However, in spite of those difficulties the progress achieved is very creditable.

Gold is also found in the detrital deposits associated with tin-ore in the Bidor district, Perak, and is recovered as a by-product from certain dredging operations in Selangor.

TABLE 20.

(b) *Annual Gold Production Statistics in Fine Ounces (Troy).*

Year.	Lode mining fine ozs.	Alluvial fine ozs.	Total fine ozs.
1936	27,811	9,968	37,779
1937	23,807	10,021	33,828
1938	30,514	9,695	40,209
1939	29,159	11,124	40,283
1940	35,000	689	35,689
1941*	24,104	700	24,804
1942†	?	?	1,024
1943†	?	?	2,213
1944†	?	?	1,212
1945†	?	?	287
1946	—	445	445
1947	3,647	1,665	5,312
1948	8,820	1,392	10,212

Appendix VII shows the production of gold by States and method of mining in fine ozs. troy.

(c) *Price of Gold.*—The official prices of gold for the year were as follows:

Gold of 900 fineness and above	...	\$69.40 per fine ounce
Gold of below 900 fineness	...	68.55 „
English sovereigns	...	17.08 each
English half sovereigns	...	8.54 „
United States dollars	...	3.50 „
Other Foreign coin	...	72.66 per fine ounce

* (January-September). † Production source unknown during Japanese "occupation".

10. **ILMENITE.**—This mineral is the principal constituent of a residue known as "amang", obtained after concentrates of tin-ore have been further cleaned in the dressing sheds. Dredging companies and large opencast mines effect the separation of "amang" from tin-ore (cassiterite) by means of magnetic separators, and this mode of separation results in a residue rich in ilmenite (FeO , TiO_2).

TABLE 21.

Annual Exports of Ilmenite from Malaya.

Year.	Exports. Tons.	Value.* \$
1935	2,431	7,371
1936	10,331	26,803
1937	6,252	13,423
1938	6,462	16,155
1939	11,098	27,614
1940	2,555	2,555
1941 (January-September)...	44	461
1946	Nil	—
1947	13,081	13,081
1948	13,566	13,566

TABLE 22.

Monthly Exports of Ilmenite from Malaya for 1948.

Month.	Tons.	Value.* \$
January	1,600	1,600
February	1,510	1,510
March	15	15
April	500	500
May	—	—
June	2,030	2,030
July	2,000	2,000
August	715	715
September	1,250	1,250
October	1,000	1,000
November	1,250	1,250
December	1,696	1,696
Total	13,566	13,566

11. **IRON-ORE.**—Mining for iron ores has not re-started since the liberation, but the opening of the mine in Dungun, Trengganu, which was previously worked by the Japanese pre-war, is under consideration, and it is hoped that during 1949 this mine will again become a producer. The stock-pile of iron-ore at the Dungun mine wharf loading site which was left by the Japanese is now being exported.

* The value for assessment of export duty is fixed at \$1 per ton.

TABLE 23.

*Production and Export of Iron-ore from Mines in Malaya
from 1935 to 1948.*

(Tons).

Year.	Kelantan.	Trengganu.	Johore.	Perak.	Total production.	Total exports.
1935	—	816,744	594,891	—	1,411,635	1,411,635
1936	—	1,064,259	590,288	449	1,654,996	1,654,547
1937	—	991,119	519,339	1,147	1,560,828	1,660,342
1938	49,223	905,316	549,960	923	1,610,099	1,615,176
1939	159,900	1,048,937	681,886	768	1,942,521	1,939,850
1940	210,930	1,109,715	625,550	957	1,962,463	1,935,314
1941 (Jan.-Sept.)	226,241	680,275	314,003	715	1,148,977	1,149,199
1942	154,697	90,660	—	116	90,776	—
1943	—	30,718	—	17,643	48,361	—
1944	11	1	—	10,441	10,453	—
1945	—	—	—	13,375	13,375	—
1946	—	—	—	—	—	—
1947	—	—	—	888	888	—
1948	—	—	—	641	641	71,113
1948 Month.	—	—	—	—	—	—
January ..	—	—	—	46	46	20
February ..	—	—	—	55	55	—
March ..	—	—	—	53	53	6
April ..	—	—	—	57	57	16
May ..	—	—	—	64	64	7
June ..	—	—	—	43	43	3
July ..	—	—	—	27	27	10
August ..	—	—	—	30	39	—
September ..	—	—	—	32	32	26,567*
October ..	—	—	—	95	95	33,936*
November ..	—	—	—	65	65	10,057*
December ..	—	—	—	65	65	491
Total ..	—	—	—	641	641	71,113

12. KAOLIN OR CHINA CLAY.—This mineral is worked on a small scale, chiefly for use in local industries. The principal sources are Tapah, Perak; Cheras, Selangor and South Johore. Large deposits are available elsewhere in the country. Production in 1948 totalled 923 tons, which was used locally.

TABLE 24.

Annual Production of Kaolin or China Clay.

Year.	Tons.	Value. \$
1936	121	3,025
1937	293	7,325
1938	1,153	28,825
1939	494	12,350
1940	408	8,172
1941 (January-September)	823	16,201
1942	—	—
1943	—	—
1944	—	—
1945	—	—
1946	241	—
1947	1,003	4,765
1948	923	44,230

* Includes old stocks exported from Trengganu.

13. MANGANESE-ORE.—There has been no exploitation of the pre-war mines since the liberation. Table 25 gives the pre-war production and export figures.

TABLE 25.
*Annual Production and Exports of Manganese-ore
from Mines in Malaya.*

Year.	Kelantan. Trengganu.		Total Produc- tion.	Total Exports.
	Tons.	Tons.	Tons.	Tons.
1935	10,678	17,367	28,045	28,045
1936	10,006	26,770	36,776	36,776
1937	9,667	23,126	32,793	32,793
1938	8,916	23,054	31,970	31,970
1939	11,548	19,900	31,448	31,448
1940	3,141	8,400	11,541	?
1941 (Jan.-Sept.)	3,635	—	3,635	?
1942	—	—	—	—
1943	209	10,000	10,900	3,000
1944	650			
1945	41			
1946	—	—	—	—
1947	—	—	—	—
1948	—	—	—	—

14. TUNGSTEN-ORES—(a) *Wolframite*.—Occurs in several localities and has been mined in Kedah, Trengganu and Pahang. Elsewhere it has been obtained as a by-product of tin mining. Mining for this mineral is at present on a very small scale.

TABLE 26.
Production of Wolframite in Malaya.

Year.	(Tons).				Total.
	Kedah.	Perak.	Pahang.	Trengganu.	
1913-17	207	—	—	841	1,048
1918-22	927	—	—	1,505	2,432
1923-27	492	—	—	707	1,199
1928-32	602	—	—	270	872
1933-37	565	—	—	350	915
1938	169	—	—	120	289
1939	174	—	—	140	314
1940	124	—	—	152	276
1942	—	—	19.8	—	19.8
1943	59.5	0.1	21.5	33.7	—
1944			29	54.7	—
1945	—	—	—	—	—
1946	—	—	—	—	—
Selangor.					
1947	2	—	3	27	33
1948	12	—	—	32	46

(b) *Scheelite*.—The small tonnage produced during the year was from Kramat Pulai Limited in Kinta district, Perak, and was obtained from small scale operations and dump retreatment.

TABLE 27.

Production of Scheelite in Malaya.

Year.	Tons.
1916-20	1,004
1921-25	116
1926-30	1,107
1931-35	4,461
1936	1,364
1937	836
1938	573
1939	174
1940	56
1941 (January-September)	13
1942	16.2
1943	52.3
1944	82.8
1945	10.5
1946	—
1947	11
1948	29

15. SUMMARY OF PRODUCTION ACTIVITIES, 1948.—A summary of production activities for 1948 is given in Appendix VIII wherein are tabulated figures in respect of each mineral produced during the year.

16. TAILINGS RETENTION.—As a means of control of residues from treatment operations, all mines are required to construct retention areas into which tailings are deposited. The effluent water discharged therefrom must contain less than 800 grains of solid matter per gallon. In some instances the restriction has been intensified because of some special local reason, while in one or two others the restriction has been slightly relaxed. The effluent discharged from tailings retention areas is frequently sampled, and if found to contain solid matter in excess of 800 grains per gallon, suitable action is immediately taken. Dredging companies generally are required to re-slime their worked out areas.

It has been found by the Agricultural Department by experiment in various areas prior to the war that re-slimes areas are suitable for growing padi and other crops. In addition, that Department has carried out experiments which have shown that padi can be successfully irrigated by means of water containing slimes from current mining operations.

During the year padi has been grown with considerable success at Kalumpang, Selangor; Kampar, Perak and Jelapang, Perak, when irrigated with mine effluent containing a considerable quantity of solid matter in the nature of slimes.

17. RIVER DEVIATIONS.—The work of stabilization and improvement of rivers and streams which suffered through lack of maintenance during the Japanese occupation was continued during the year. A number of river deviations were satisfactorily carried out in consultation with the Drainage and Irrigation Department, and some of them were completed and brought into use.

18. WEATHER.—An unusually dry December caused a great reduction of working hours in many hydraulic and gravel pump mines. In Upper Perak and parts of Kinta district the annual rainfall was well below the average. The expected rains towards the end of the year brought little relief, and the water position on some mines was a cause for anxiety at the close of the year.

Table 28 includes recordings of total rainfall at observation stations adjacent to mining district.

TABLE 28.
Rainfall Recordings.

State.	1937.	1938.	1939.	1946.	1947.	1948.
Perak.—						
Tanjong Rambutan ..	106.43	92.75	96.90	—	128.96	82.21
Kampar ..	145.82	128.23	128.17	138.63	161.85	142.49
Tapah ..	153.66	140.20	132.80	131.80	147.41	114.10
Selangor.—						
Kuala Lumpur ..	102.81	98.18	59.28	108.12	105.45	94.40
Negri Sembilan.—						
Seremban ..	107.61	84.06	84.35	95.81	95.77	82.72½
Pahang.—						
Bentong ..	—	—	84.04	84.07	105.68	77.70
Kuantan ..	—	—	120.69	—	175.40	113.63
Johore.—						
Kota Tinggi ..	—	—	—	113.55	113.28	151.01
Mersing ..	—	—	—	52.80	129.27	106.25
Trengganu.—						
Kuala Dungun ..	—	—	—	—	—	80.06
Kedah.—						
Kulim ..	—	—	—	—	—	99.84
Perlis.—						
Kaki Bukit ..	—	—	—	—	—	69.35
Malacca.—						
Jasin ..	—	—	—	—	—	88.18

PART IV.

FINANCIAL AID BY GOVERNMENT TO THE MINING INDUSTRY.

19. FINANCIAL AID TO EUROPEAN-OWNED MINES.—In 1946 and 1947 the principal source of financial aid had been through the Colonial Office—Ministry of Supply, London, but early in 1948 the system was modified, inasmuch as the approval for such assistance was issued direct by the Financial Secretary, Federation of Malaya. The recommendations concerning applications were formerly made by officers of the Ministry of Supply, but this work was transferred to the Federation of Malaya, and came under the scope of the Mines Department, and Mr. F. T. M. White, Inspector of Mines, was seconded for this work.

The broad principles operative in 1947 continued to apply. The Secretary of State for the Colonies, in March, 1946, had outlined the principles on which financial assistance would be made available for the rehabilitation of European-owned tin mines

in Malaya. Dredges in Categories "A", "B" and "C" of the Storke Report would be eligible to receive financial assistance by way of loans, the right of refusal being reserved in those cases where the life and estimated profits of the property appeared insufficient to warrant the granting of a loan. The same assistance would also be available to tin mines other than dredges. Applications for financial assistance on the foregoing terms were to be accompanied by full available information regarding the properties concerned and the claims for war damage compensation. The assistance would take the form of advances for the purposes of carrying out approved rehabilitation programmes. Advances and loans would be a first charge on the repaired assets, and would be off-set against any war damage compensation. In the case of dredges, any debit balance remaining would be repayable in equal instalments over a period of 15 years (or less at the option of the company), with interest at the rate of 3 per centum per annum accruing from the date of the first advance. In the case of gravel-pump, opencast, hydraulic and lode mines, the period of repayment would be ten years, the rate of interest being the same as for dredges. Repayment of capital and payment of interest would not commence until a decision had been reached on claims for war damage compensation or on 1st January, 1950, whichever was the earlier.

Where loans have been approved, advances have been paid at intervals to keep pace with the rehabilitation expenditure, such advances being made available locally from the Treasury in Kuala Lumpur or through the Crown Agents for the Colonies in London, according to the purpose for which the advances were required. In general up to 70 per cent. of the approved cost of rehabilitation has been made available by way of advances pending the completion and execution of legal documents; in some special cases, 90 per cent. of the approved loan has been granted. As to rehabilitation loans under this heading, 75 applications have been made since the inception of the scheme, of which 68 had been approved in whole or in part at 31st December, 1948, by which date also a total sum of \$49,335,337 had been made available by way of advances under this scheme. Advances during the year totalled \$19,798,100. The rate at which the advances were made available under this scheme is shown in Appendix IX, which also shows the progressive production from "aided" European-owned mines during the year. The number of applications still awaiting analysis and consideration at the end of the year was four. No further new applications will be considered if submitted after 31st December, 1948.

Throughout the year a fairly steady increase of production of tin-ore concentrates from European mines took place. In January, 1948, 45,124 piculs were produced as compared with 52,370 piculs in December, 1948.

The statistics for machinery actively engaged in mining (*see* Appendix XVI) shows a very considerable increase in horse-power throughout the year.

20. INDUSTRIAL REHABILITATION FINANCE BOARD.—This Board was established with effect from 1st April, 1947, under Ordinance No. 20/47 and amended by Ordinance No. 10/48 with effect from 1st January, 1948. During the year the Chief Inspector of Mines was made a member of the Board. The function of this Board was the granting of financial assistance

by way of loans to industry generally. With regard to the mining industry, facilities were available to mines whose applications were not considered in the scheme outlined in paragraphs 19 and 21 of this report, and was not confined to any specific mineral.

The following mines were approved loans by the Board:

Two tin mines—loans totalling \$3,380,000.

Two gold and a coal mine—loans totalling \$7,550,000.

The two tin mines which were approved loans had not started to rehabilitate at the end of 1948, but one gold mine operated throughout the year and the coal mine also continuously produced during the year.

21. FINANCIAL ASSISTANCE TO CHINESE MINES.—This continued to be available from the Chinese Tin Mines Rehabilitation Loans Board throughout the year. Briefly the functions of this Board, with which the Mines Department has been intimately associated, may be outlined as providing financial assistance, by way of secured loans to Chinese tin miners, to enable them to rehabilitate their tin-mining properties which had suffered damage as a result of the Japanese war. The Board's activities were governed by Ordinance No. 9/47 and an amendment under Ordinance No. 30/47.

The Financial Secretary is Chairman and the Chief Inspector of Mines is Deputy Chairman of this Board, which consists of four unofficial and three official members.

In assessing the degree of financial assistance to be rendered to any particular mine, the Board has been greatly assisted by the various branches of the Mines Department, and by boring results made available by the Geological Survey. It has been found necessary to ask for progress reports on each loan mine from the Inspector of Mines, which has increased the work of these officers considerably. Mr. F. T. M. White was seconded to this Loans Board as Technical Adviser, and has been a great help to the Board.

A progressive survey of the work of the Board in 1948 is given in Appendix X, which affords comparison between:

- (i) the progress in the number of loan applications approved;
 - (ii) the progress in total amounts of loans approved;
 - (iii) the progress in total cash allocations by way of (a) cash advances and (b) credits to the Technical Adviser's Machinery Reserve,
- and
- (iv) the progress in the "aided" Chinese mines reaching the production stage, and
 - (v) the monthly production of tin-ore concentrates from "aided" Chinese mines, together with estimations as to the value of (a) such production and (b) export duty leviable thereon.

Out of the 390 mines in respect of which financial assistance has been approved, 282 were in actual production at 31st December, 1948, 264 were gravel-pump mines and 18 were of

other types, principally hydraulic and opencast. The reasons for the difference in the number of loans approved and the number of mines in production are because of such factors as:

- (i) a number of "aided" mines were in course of rehabilitation, e.g., dewatering, construction and assembly of equipment, etc., and will enter production in 1949;
- (ii) a number of mines under the same ownership have been granted individual loans but have been "grouped", thereby enabling funds in respect of two or more mines to be utilised upon a selected fewer number in order to speed rehabilitation, on the condition that the other mines of the "group" would be progressively rehabilitated out of profits from those previously rehabilitated;
- (iii) the rehabilitation of a few mines in receipt of assistance has been held up because of insecurity of the site during the emergency, and for which alternative sites were being sought, and
- (iv) the compliance with conditions attached to the loans in the case of those "approved conditionally".

With regard to actual allocations, the credits to "T.A.A." (Technical Adviser's Account—Machinery Reserve), are in respect of diesel engines, pumps, piping, etc., given as part of the loans and made available under the "Machinery for Mines Scheme", which will be dealt with later in a separate short section of this report.

The financial assistance rendered by Government has been a most important factor in achieving the very satisfactory progress of this section of the industry, and without which rehabilitation would have been seriously retarded.

22. SUMMARY OF FINANCIAL ASSISTANCE FOR REHABILITATION.—The measures of financial assistance for rehabilitation of the Mining Industry of the Federation afforded by the various schemes outlined in the foregoing may be summarised briefly as follows:

Financial Allocations available at 31st December, 1948:

(i) Tin Mining Industry—			
(a) from Financial Secretariat...	\$49,335,337		
(b) from Industrial Rehabilitation Finance Board ...	3,330,000		
(c) from Chinese Tin Mines Rehabilitation Loans Board:			
(i) Cash advances ...	12,841,698		
(ii) Allocations from "Machinery for Mines Scheme" ...	4,322,312		
			\$69,829,347
(ii) Gold and Coal Mining Industries—			
from Industrial Rehabilitation Finance Board ...	\$7,550,000		
			7,550,000
Grand Total ...	\$77,379,347		

23. MACHINERY FOR MINES SCHEME.—Under this scheme Government sponsored the import of equipment such as diesel engines, gravel pumps, water pumps, piping, belting, etc., in order to expedite the supply of these materials to the Chinese miners.

The scheme was administered by Mr. F. T. M. White, Technical Adviser to the Chinese Tin Mines Rehabilitation Loans Board. The total f.o.b. cost of the equipment ordered, which was placed through the Ministry of Supply, was approximately \$6,000,000. The equipment which started to arrive in the latter half of 1946, had almost completely arrived by the end of 1948. It was found that some of this equipment would not be required by the mines, and as other industries being rehabilitated badly required that equipment it was diverted to them.

The overall position of the scheme is as shown in Appendix XI.

It is of interest to record that the total horse-power of diesel engines released under this scheme to "aided" Chinese mines as at 31st December, 1948, was 33,247 h.p., a figure representing 25.4 per cent. of the total diesel horse-power employed in the whole tin-mining industry in 1941. This figure is not inclusive of the engines disposed of by cash purchase to other interests.

PART V.

EMPLOYMENT.

24. EMPLOYMENT.—During the first months of the year, labour on Chinese mines demanded higher and higher wages; in spite of the attempts of the Malayan Mining Employers Association to regulate increases, certain miners acceded to the demands under threat of having their mines and equipment flooded as a consequence of a strike by the whole labour force. Where part of a labour force was willing to continue to work intimidation resulted. With the beginning of the "Emergency" many trade unions were declared illegal and most of the leaders disappeared, miners were no longer threatened with strikes, but much of the labour became surly and undisciplined.

Whilst in the first half of the year rehabilitation was not being influenced by the "Emergency" there was a steady increase in the labour force employed on mines, but since June rehabilitation has slowed down, and the continuous increase which was seen during the first half of the year was not maintained. The total number employed at the end of the year shows an increase of 20 per cent. compared with December, 1947, whilst the number of Malays employed has increased by 75 per cent. Chinese, who comprise 69 per cent. of the total employed, are mainly engaged on gravel pump mines.

TABLE 29.

Monthly Statistics of Labour Employed on Mines, 1948.

Month.	Tin.	Coal.	Gold.	Miscellaneous.	Total.
January	40,544	2,602	585	78	43,809
February	41,420	2,619	733	111	44,883
March	42,573	2,654	660	149	46,036
April	43,337	2,664	682	122	46,805
May	43,452	2,613	607	126	46,798
June	44,117	2,590	642	122	47,471
July	45,412	2,509	631	117	48,669
August	46,111	2,370	600	1,016	50,097
September	46,373	2,354	594	931	50,252
October	46,304	2,381	610	1,049	50,344
November	46,761	2,432	646	1,108	50,947
December	46,858	2,172	617	1,620	51,267
1947	39,362	2,813	529	44	42,748
1941	77,712	5,909	3,031	147	86,799

TABLE 29A.

Labour Employed on Mines, by States at 31st December, 1948.

States.	Europeans.	Chinese.	Indians.	Malays.	Other Nationalities.	Total.
Perak	232	19,308	3,750	4,364	278	27,032
Selangor	156	9,923	2,687	1,447	58	14,276
Negri Sembilan	10	1,231	77	282	3	1,656
Pahang	48	2,171	119	575	57	2,970
Johore	3	537	16	75	2	633
Trengganu	10	593	157	1,438	—	2,203
Kedah	3	204	33	92	—	422
Perlis	—	912	—	15	—	927
Kelantan	—	—	—	—	—	—
Malacca	—	221	1	4	25	251
Totals	462	35,258	6,840	8,292	423	51,270
1947	436	30,076	6,447	4,742	1,047	42,748
1941	Classification not available.					86,799

A full analysis of the employment statistics is given in Appendix XII. Tables 29 and 29A do not include holders of dulang passes of which 20,281 were valid on 31st December, 1948. For production figures *see* Table 13. Each pass was limited to 45 kattics sales per month.

25. WAGES.—The following Table 30 shows the monthly wages paid for skilled Asian mine workers and per shift for unskilled labourers employed in the industry:

TABLE 30.
Comparative Wage Rates in the Mining Industry.
Average Wage, etc.

Occupation.	1941.	1947.	1948.								
			Perak.	Selangor.	Negri Sembilan.	Pahang.	Johore.	Trengganu.	Kedah.	Perlis.	Malacca.
	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
Kepalas (Foremen) ..	60—75	139.20	137.40	145.02	158.65	152.00	145.00	130.00	150—200	180.00	148.75
Assistant Kepalas ..	40—45	110.00	98.60	108.57	111.48	105.00	107.50	85.00	100—130	160.00	132.50
Fitters ..	40—60	127.05	119.00	115.48	125.55	142.00	119.60	90.00	200.00	160.00	120.00
Carpenters ..	35—45	120.00	123.00	89.60	105.00	113.00	80.00	94.00	180.00	180.00	120.00
Engine Drivers ..	55—70	170.00	124.20	136.03	129.33	174.00	145.00	88.00	120.00	150.00	170.00
Assistant Engine Drivers ..	40—50	130.00	92.00	89.26	91.66	88.00	95.00	65.00	80.00	130.00	130.00
Electricians ..	65—75	150.00	125.60	126.03	—	150.00	—	250.00	—	150.00	—
Assistant Electricians ..	35—55	—	89.10	66.08	—	120.00	—	66.00	—	130.00	—

Per Shift of eight hours.

	c.	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
Unskilled labourers (all labour not mentioned above)	40—60	—	—	—	—	—	—	—	—	—	—
Pong Sau ..	—	1.30—2.80	1.64	1.73	1.64	1.48	1.50	2.83	1.70	3.00	1.57
Chap Kong ..	—	1.13—2.60	1.35	1.50	1.61	1.36	1.37	2.11	1.60	2.80	1.42
Kongsi Kong ..	—	1.00—2.30	1.26	1.44	1.49	1.25	1.37	2.14	1.50	2.50	1.14
Indians *	—	1.65—2.19	1.85	1.33	2.31	2.02	—	1.84	2.40	—	2.33
Chinese Women *	—	0.90—2.10	1.85	1.89	1.83	1.80	1.20	2.45	1.20	2.20	2.36
Daily cost of feeding ..	—	1.01—1.77	0.96	1.02	1.06	1.05	1.35	—	1.00	1.50	1.15

* Free food is provided except for these categories.

As will be seen from the above statistics there has been an increase in the wage rates compared with 1947.

PART VI.

ACCIDENTS TO LABOUR ON MINES.

26. FATAL ACCIDENTS.—The statistics relating to pre-war accidents cover only the States of Perak, Selangor, Negri Sembilan and Pahang, but subsequent figures relate to Malaya as a whole. Fatal accidents classified according to methods of mining are tabulated in Table 31.

TABLE 31.

Total Fatal Accidents, 1948.

States.	Dredg- ing.	Gravel pumping.	Open- cast.	Under- ground.	Hydrau- lic.	Miscellaneous (accidents not occurring in a mine).	Total No. of accidents.
Perak ..	3	5	—	—	2	3	13
Selangor ..	—	1	—	—	—	—	1
Negri Sembilan ..	—	1	—	—	—	—	1
Pahang ..	—	—	—	3	—	—	3
Johore ..	1	—	—	—	—	—	1
Trengganu ..	—	—	—	—	—	—	—
Kedah ..	—	—	—	—	—	—	—
Perlis ..	—	—	—	2	—	—	2
Kelantan ..	—	—	—	—	—	—	—
Malacca ..	—	—	—	—	—	—	—
Total ..	4	7	—	5	2	3	21
1947 ..	3	11	1	2	—	—	17

TABLE 32.

Statistics showing Comparison between Number of Fatal Accidents and Average Monthly Number of Persons employed in the Mining Industry.

Year.	Number.	Average monthly labour force.	Fatality rate per 1,000 men employed.
1937 ...	75	88,285	0.85
1938 ...	56	57,663	0.97
1939 ...	43	72,954	0.59
1940 ...	?	91,145	—
1941 ...	?	86,799	—
1946 ...	8	26,019	0.31
1947 ...	17	31,111	0.546
1948 ...	21	46,444	0.45

TABLE 33.

Statistics showing Comparison between Number of Fatal Accidents and Number of Persons employed in the Mining Industry in each State, 1948.

States.	Number.	Average monthly labour.	Fatality rate per 1,000 men employed.
Perak	13	26,318	0.494
Selangor	1	11,682	0.09
Negri Sembilan ...	1	1,719	0.58
Pahang	3	2,537	0.85
Johore	1	633	1.58
Trengganu	—	2,203	—
Kedah	—	422	—
Perlis	2	700	2.86
Kelantan	—	—	—
Malacca	—	230	—
Totals	21	46,444	0.45

Appendices XIII and XIV give further analysis of the 1948 fatalities.

PART VII.

27. MACHINERY AND POWER USED ON MINES.—Delays experienced in the delivery of new equipment were not so marked as in 1947, but they are still having a retarding effect on rehabilitation of the industry. Electric power in Selangor has been rationed, but towards the end of the year under review the quantity of power available was increased. This shortage has been due to lack of equipment but the position is gradually being improved. The total horse-power in use by mines of all kinds at the close of the year was 244,746 H.P.

Detailed machinery statistics for pre-war years 1946, 1947 and 1948 are at Appendices XV and XVI wherein machinery is classified by States, methods of mining, minerals mined and type of fuel or source of power used.

TABLE 34.

The following are approximate costs of power and supplies, etc., during 1948:

Approximate Costs of Power, Stores, Etc., 1948.

Item.	Perak.	Selangor.	Negri Sembilan.	Pahang.	Johore.	Trengganu.	Kedah.	Perlis.	Kelantan.	Malacca.
	\$ c.	\$ c.	\$ c.	\$ c.	\$ c.	\$ c.	\$ c.	\$ c.	\$ c.	\$ c.
Electricity per unit (from Power Co. or Government)	3 54	3 79	—	—	—	—	—	—	—	—
High speed diesel oil per gallon	53	52	53	60	60	1 03	56	65	—	50
Low speed diesel oil	47	47	47½	55	57	74	54	60	—	46
Coal per ton c.i.f.	—	23 10	—	38 00	—	—	—	—	—	—
Iron Castings per lb.	28½	25	24½	35	28	25	25	25	—	22
Palong Planks (16' × 12" × 1½")	4 93	3 88	3 98	4 03	6 25	5 17	5 50	6 00	—	4 00
Palong Poles (30' long, per 1" diam.)	1 99	70	1 04	66	80	2 50	1 50	1 60	—	47
Cement per bag	4 84	4 73	5 12	5 11	6 50	6 31	4 40	5 00	—	5 00
Nails per lb.	31½	33	36	32	—	39	40	40	—	29½
Attaps per 1,000	48 00	68 78	139 44	27 00	—	56 00	35 00	60 00	—	45 00

PART VIII.

MACHINERY BRANCH.

28. HISTORY.—The Machinery Branch was originally formed for the inspection of portable steam boilers and engines employed in the early days of mining in Malaya. Supervision of these boilers was necessary, especially in view of the elementary knowledge of the staffs in charge, and Government enlisted the part-time services of steam engineers employed by commercial companies. The position was regularised about 1907 when it is believed the first Inspectors of Boilers were appointed by Government. A rapid expansion of mechanisation of mines and of other industries followed and the Inspectors of Boilers, later Inspectors of Machinery, became responsible for the inspection of other forms of prime movers such as gas and oil engines and of the machinery driven thereby. Later the additional duties now obtaining were imposed on the Inspectorate.

29. MACHINERY ENACTMENTS.—The Enactments and Ordinance at present in force, under which the Machinery Branch operates are:

The Machinery Enactment, F.M.S. (Cap. 202).

The Machinery Enactment, Johore (No. 62).

The Machinery Ordinance, S.S. (Cap. 206).

The Steam Boilers and Engines Enactment, Kedah (No. 117).

The duties under the above Enactments and Ordinance include the survey of steam boilers, steam engines, other prime movers, pressure vessels; the inspection of all machinery and the certification of machinery staff. Examinations of candidates for Certificates of Competency as Engineers and Dredgemasters and the viva-voce examination of engine drivers are carried out as well as the investigation of all accidents to persons in connection with machinery and the serious breakdown of machinery. In Kedah the Enactment limits the above duties to the inspection of steam machinery and the investigation of accidents.

In effect, the work done by the Machinery Branch is that which is carried out in the United Kingdom by Board of Trade Surveyors; the Boiler and Machinery Insurance Companies, and Inspectors of Factories under the Factories Act. Machinery Insurance Companies, which operate on a large scale in the Federation of Malaya, employ no insurance inspectors and rely upon the Certificates of Fitness issued by this Branch.

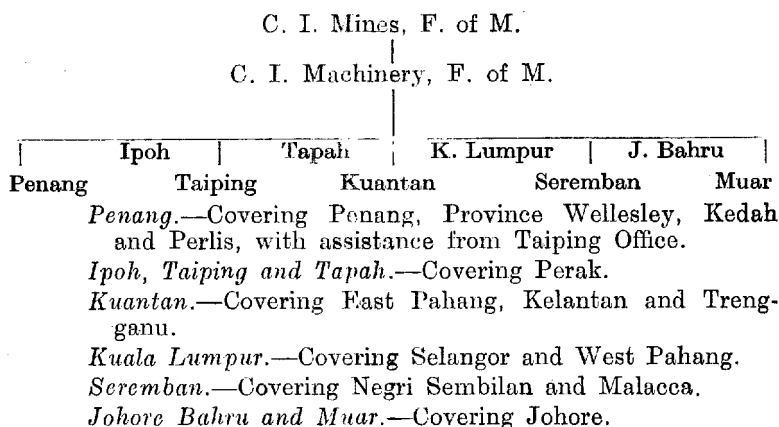
The machinery under inspection comprises all machinery in the Federation of Malaya, except certain electrical machinery, that operated by the Malayan Railways and vehicles. Such machinery, which may be operated only under Certificates of Fitness, is chiefly in use in Government and commercially-owned Power Stations; by Government Departments, and in the Mining, Rubber, Palm Oil, Rice Milling, Fruit Canning, and other industries established in the country.

The aggregate horse-power of machinery in operation is still unknown, as with the skeleton staff available it has not been possible to cover all the Federated States: and Pahang, Trengganu, Kelantan and Perlis contain large areas where shortage of staff has prevented machinery inspections. There is no legislation covering machinery in these States. The horse-power of boilers and prime movers under Certificate at the end of the year totalled approximately 253,000.

Much time has been occupied, both by the staff at Headquarters and the Inspectorate, in duties not normally carried out by the Machinery Branch. It has thus been necessary to carry out valuations of machinery in charge of the Custodian of Property, for the Rehabilitation Loans Board and of Japanese reparations machinery, in addition to duties on tender boards.

30. ADMINISTRATION AND STAFF.—The Machinery Branch prior to the 1941 war in Malaya was attached to the Mines Department; after the liberation and the return of the Civil Government in April, 1946, the Machinery Branch was attached to the Public Works Department but in January, 1948, it was transferred back to the Mines Department.

The Inspectorate organization is shown in the following chart:



Of the above offices, Taiping, Tapah, Kuantan and Muar are not yet opened due to shortage of staff and office accommodation. No provision has yet been made for offices in the States of Kelantan, Perlis and Trengganu.

At the end of 1947 six officers were available to fill twelve duty posts, and by the end of 1948 only eight of the posts were filled.

31. MACHINERY INSPECTED.—Shortage of staff prevented the full number of inspections as required by the various Enactments, in fact inspections fell far short of requirements, but the more potentially dangerous machinery was inspected.

Table 36 shews details of the machinery inspected and certificated, but this does not represent the total in operation, as in pre-war reports. The horse-power of prime movers under certificate at the end of the year was as follows:

Boilers 101,437 H.P., Oil Engines 139,874 H.P., Gas Engines 2,113 H.P., Water Turbines 9,855 H.P., and the total horse-power was 253,279, which represents an increase of 98 per cent. compared with 1947.

It should be noted that "horse-power" is an obsolete term as applied to boilers, which in future will be assessed on heating surface only. The boiler "horse-power" quoted above is empirical and is included for comparison and continuity with previous reports.

32. NEW PRIME MOVERS.—A total of 28,794 horse-power of new boilers and prime movers was installed during the year, and details are shown at Table 35. This figure is included in the totals given in paragraph 31. Included in this total are 94 Paxman and Ruston Hornsby oil engines, which practically completed the delivery of the engines specially ordered for the rehabilitation of mines. Ninety-five per cent. of the total horse-power of new machinery was of Empire origin, and was chiefly of United Kingdom manufacture.

In addition to prime movers a considerable number of new gasholders (pressure vessels) have been installed during the year for the storage and pressure discharge of liquid latex. These have been fabricated locally from imported materials to the design of this Department.

Rubber Estates have installed very little new factory machinery during the year but a number of additional pressure tanks of large capacity for storing latex have been erected in Selangor.

Engineering Workshops, almost 100 per cent. Chinese-owned, seem to have revived to a large extent their pre-war activities with the financial aid of the Industrial Rehabilitation Loan Board, and the arrival of some 400 second-hand machine tools ex Japan was arranged by the U.K. Reparations Committee in Tokyo, and distributed mainly in Perak and Selangor.

TABLE 35.
New Boilers and Prime Movers installed, 1948.
(New Boilers.)

	British manufacture.		Foreign manufacture.		Total.	
	No.	H.P.	No.	H.P.	No.	H.P.
Johore ..	—	—	1	230	1	230
Malacca ..	—	—	—	—	—	—
N. Sembilan ..	—	—	—	—	—	—
Penang ..	2	44	—	—	2	44
Perak ..	2	177	—	—	2	177
Selangor ..	—	—	—	—	—	—
Total ..	4	221	1	230	5	451

New Internal Combustion Engines.

	British manufacture.		Foreign manufacture.		Total.	
	No.	H.P.	No.	H.P.	No.	H.P.
Johore ..	39	2,770	4	37	43	2,807
Malacca ..	5	288	1	40	6	328
N. Sembilan ..	13	236	1	120	14	356
Penang ..	28	548	—	—	28	548
Perak ..	199	13,918	5	394	204	14,312
Selangor ..	57	4,650	4	342	61	4,992
Total ..	341	22,410	15	933	356	23,343

Accidents involving Grievous Hurt Investigated.

The following record is probably incomplete as some accidents may not have been reported :

TABLE 39.

	Mining.			Agriculture.			General.			Government.			Total.		
	Death.	Serious.	Minor.	Death.	Serious.	Minor.	Death.	Serious.	Minor.	Death.	Serious.	Minor.	Death.	Serious.	Minor.
1947 Total	2	6	—	2	1	2	1	7	1	1	1	—	6	15	3
1948 Total	2	3	1	2	8	5	2	8	3	—	1	—	6	20	9
Johore	—	—	1	2	2	5	1	3	3	—	—	—	3	5	9
Perak	1	1	—	—	1	—	—	4	—	—	1	—	1	7	—
Selangor	1	2	—	—	5	—	1	1	—	—	—	—	2	8	—

No accidents were investigated in Kedah, Malacca, Negri Sembilan, Pahang or Penang.

37. ACCIDENTS TO MACHINERY.—Thirteen major breakdowns of machinery were reported and investigated during the year. In all these cases oil engines were involved. In 9 of these cases the breakdown was due to the failure of the crankshaft. Arising from breakdowns of certain types of engine, proposals for the modification of the design and equipment of these engines have been discussed with the local representatives of the manufacturers.

38. BOARD OF EXAMINERS.—Examinations were held throughout the year in Penang, Perak, Selangor and Johore, and occasionally in Negri Sembilan and Malacca. Examinations were held for Certificates of Competency as 1st and 2nd Grade Engineers, Dredgemasters, and 1st and 2nd Grade Engine Drivers. Details are shown in Table 40. In all, 1,063 candidates were examined, of whom 859 were successful. This compares with 650 candidates examined and 566 passes in 1947, increases of 64 per cent. and 52 per cent., respectively. Of the 44 candidates for Engineers' and Dredgemasters' Certificates, 30 or 68 per cent. passed. Of the 1,019 candidates for Engine Drivers' Certificates, 829 or 81 per cent. were successful.

TABLE 40.

Board of Examiners.

Results of Examinations held in 1948.

	ENGINEERS.						DREDGE-MASTERS.			ENGINE DRIVERS.						TOTAL.		
	1st Grade.			2nd Grade.			No.	Presented.	Failed.	1st Grade.			2nd Grade.			No.	Presented.	Failed.
	No.	Presented.	Passed.	No.	Presented.	Failed.				No.	Presented.	Passed.	No.	Presented.	Failed.			
Johore	1	—	—	5	4	1	—	—	—	35	30	5	111	94	17	152	123	24
Malacca	—	—	—	—	—	—	—	—	—	1	1	—	14	14	—	15	15	—
N. Sembilan	—	—	—	—	—	—	—	—	—	13	12	1	30	24	6	52	46	6
Pahang	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Penang	—	—	—	1	1	—	—	—	—	21	13	8	119	99	20	141	113	28
Perak	2	1	1	2	2	—	21	15	6	108	80	28	229	188	41	362	296	76
Selangor	1	—	—	4	3	1	7	4	3	68	59	9	201	205	56	341	271	70
Total	4	1	3	12	10	2	28	19	9	246	195	51	773	634	139	1,063	859	204

The following Certificates of Competency were issued in addition to the above:

Without Examination to eight 1st Grade and two 2nd Grade Engineers, two Dredgemasters, five 1st Grade and three 2nd Grade Engine Drivers, holding necessary qualifications.

Endorsements.—13 Engine Drivers obtained endorsement of certificates following examination.

Duplicate Certificates.—178 Duplicate Certificates were issued, three to Engineers, eight to Dredgemasters and 167 to Engine Drivers. In the majority of cases the original certificates had been lost or destroyed during enemy occupation.

Restricted Certificate.—One restricted certificate was issued to one Dredgemaster.

PART IX.

MINERAL ORES AND STATISTICS BRANCH.

(MINERAL ORES ENACTMENT CAP. 148).

39. *DUTIES*.—This Branch is responsible for the compilation of complete records of all minerals mined in the country, and the supply of statistics concerning mineral production to Government Departments, International Tin Study Group, Ministry of Supply, Tin Research Institute and many other establishments. It is responsible for the publication of the Quarterly and Yearly Statistical Bulletin relating to the Mining Industry, which is despatched to all parts of the world. The data shown in the Bulletin is now recognised as the authentic figures for the Federation of Malaya.

Under the Mineral Ores Enactment all officers of this Branch are empowered to inspect Licensed Mineral Ore buyers' books, stocks of mineral, authorities for sale and permits to transport minerals.

40. *LICENCES ISSUED UNDER THE MINERAL ORES ENACTMENT*.—

TABLE 41.

Tin-ore Buyers Licences issued.

Year.	Europeans.	Chinese.	Japanese.	Total.
1936	17	94	2	113
1937	16	97	2	115
1938	18	101	1	120
1939	17	98	1	116
1940) 1941)	No records.			
1946	2	105	—	107
1947	11	108	—	119

TABLE 42.

Tin-ore Buyers Licences issued by States, 1948.

States.	Europeans.	Chinese.	Total.
Perak	7	72	79
Selangor	4	27	31
Negri Sembilan	1	5	6
Pahang	—	3	3
Johore	—	3	3
Kedah	1	2	3
Perlis	—	1	1
Total	13	113	126

NOTE.—Licences issued to Japanese were for the purchase of "amang" from which ilmenite is extracted.

TABLE 43.

Tin-ore Buyers Sub-licences issued.

Year.	Chinese.	Total.
1936	67	67
1937	72	72
1938	67	67
1939	61	61
1940 } No records.		
1941 }		
1946	29	29
1947	34	34

TABLE 44.

Tin-ore Buyers Sub-licences issued by States, 1948.

States.	Chinese.	Total.
Perak	32	32
Selangor	9	9
Negri Sembilan	1	1
Pahang	—	—
Johore	1	1
Total	43	43

PART X.

DANGEROUS TRADES ENACTMENT.

41. CALCINING LICENCES.—In some areas arsenical and iron pyrites are found associated with the tin-ore, the concentrates of which require calcining for efficient "cleaning". This is permitted only under licence and in approved types of furnace. In 1939, 66 such licences were issued, whilst in 1947 only 17 were issued.

The following table gives the figures for 1948:

TABLE 45.

States.	1948. Total licences.
Perak	7
Selangor	16
Negri Sembilan	—
Pahang	1
Johore	—
Trengganu	—
Kedah } Not applicable.	
Perlis }	
Malacca	—
Total	24

PART XI.

EXPLOSIVES ENACTMENT.

42. EXPLOSIVES.—Considerable quantities of explosives are used in connection with mining, the purchase and storage being controlled by licence.

Owing to the Emergency, close supervision over the purchase, storage and use of explosives became necessary during the latter half of the year.

The number of magazine licences issued and the quantities of explosives used during 1948 are shown in the following table:

TABLE 46.

Consumption of Explosives, 1939.

States.	Explosive licences.	Amount of explosives used.	
		Gelignite lbs.	Detonators rounds.
Perak	172	21,218	165,359
Selangor	65	77,988	16,367
Negri Sembilan	1	89	590
Pahang	33	163,227	288,507
Total	271	263,227	470,823

By way of comparison, typical monthly requirements during 1946 are given in Table 47:

TABLE 47.

Typical Monthly Explosives Requirements, 1946.

States.	Detonators (ordinary) No.	Detonators (electric) No.	Plastic "808" lbs.	Safety fuse fathoms.	Electric cable feet.
Perak	1,360	—	248	550	—
Selangor	10,765	320	8,634	9,422	4,880
Negri Sembilan	10	—	4	3	—
Pahang	200	10	24	61	—
Trengganu	600	—	550	1,210	—
Total	12,935	330	9,460	11,246	4,880

TABLE 48.

Explosives, 1948.

States.	No. of magazine licences.	Weight in lbs. of explosives used.				Gelatine dynamite.	No. of rounds of detonators used.
		Gelignite	Blasting gelatine.	Fuse.	Ammonal powder.		
				Coils.	lbs.		
Perak	121	7,386	—	—	—	—	59,910
Selangor	17	158,153	—	1,155	26,112	—	124,240
Negri Sembilan ..	2	90	—	4	—	—	450
Pahang	5	35,708	61,250	—	100	19,900	161,527
Johore	1	—	—	—	—	—	—
Trengganu	—	1,713	405	1,292	—	—	25,697
Kedah	—	60	—	17	—	—	120
Perlis	—	7,482	—	2,414	—	—	31,225
Kelantan	—	—	—	—	—	—	—
Malacca	1	185	—	148	—	—	1,198
Total	147	210,777	61,655	5,030	26,212	19,900	404,367

PART XII.

ADMINISTRATION OF THE MINES DEPARTMENT.

43. STAFF.—This Department consists of three branches—Mines, Mineral Ores and Statistics and Machinery, and Appendix XVII shows details of the organization.

During the year each branch has been understaffed both in senior and junior officers, but it is hoped that these vacancies will be filled early in 1949.

Inspectors of Mines have been stationed in Trengganu and Kedah during the year where offices have been established.

The rehabilitation of the mining industry has entailed much extra work for all officers, who have been more than fully occupied with the execution of their own normal duties. The staff have carried on with their field duties, in spite of the activities of the terrorists, but it has been necessary at times for officers to take an armed escort with them into the more dangerous regions. I am very pleased to report that the field staff have not suffered any casualties in the course of their field work, although mining fields generally have been subjected to terrorists activities.

44. DEPARTMENTAL REVENUE.—(a) *Mines, Mineral Ores and Statistical Branches.*—The total revenue derived from all sources connected with mining for 1948, excluding the Machinery Branch, amounted to \$30,144,747, and is shown, classified according to source, in Table 49.

This represents an increase of approximately 115 per cent. over the revenue of 1947, the principal item of revenue being in respect of Export Duty on Tin-ore and Tin.

TABLE 49.

Mines Department Revenue, 1948.
Total Revenue from Sources connected with Mining.

Sources.	Head- quarters.	Perak.	Selangor.	Negri Sembilan.	Pahang.	Johore.	Treng- ganu.	Kedah.	Perlis.	Malacca.	Total, 1948.	Total, 1947.
	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
(A) MINES OFFICE.												
Ore-buyers Licences	—	7,900	3,100	600	300	300	—	—	—	—	12,200	11,700
Ore-buyers Sub-licences .. .	—	160	46	5	—	5	—	—	—	—	215	170
Dulang Passes	—	13,854	5,268	520	289	147	—	—	—	—	20,178	20,927
Search, Registration, etc. .. .	—	476	11	—	—	—	—	—	—	—	487	480
Court (Sen. Inspectors) .. .	—	—	44	—	156	58	—	—	—	—	258	298
Miscellaneous Receipts:												
(i) Tribute from Sungai Bidor Tin Dredging, Ltd. .. .	—	4,397	—	—	—	—	—	—	—	—	4,397	19,009
(ii) Unclassified	1,125	2,681	26	51	8	5	—	—	—	—	3,896	964
Total	1,125	29,568	8,494	1,176	753	515	—	—	—	—	41,631	63,538
(B) LAND OFFICE.												
Premia on Mining Leases .. .	—	79,070	125,518	26,822	10,689	3,598	4,515	12,000	—	70	262,232	104,827
Rent on Mining Leases .. .	—	139,600	57,196	10,836	21,135	11,191	11,732	3,060	2,104	232	257,146	238,236
Prospecting Licences	—	—	—	50	75	—	1,190	250	—	25	1,590	452
Individual Mining Licences .. .	—	—	—	—	—	—	—	—	—	350	350	427
Miscellaneous Receipts .. .	—	—	—	—	—	—	82	75	114	—	271	794
Total	—	218,730	182,714	37,708	31,849	14,789	17,519	15,385	2,218	677	521,589	404,786
(C) EXPORT DUTY AND ROYALTY.												
Export Duty on Tin-ore and Tin .. .	29,429,689	—	—	—	—	—	—	—	—	—	29,429,689	13,461,879
Export Duty on Wolfram .. .	2,121	—	—	—	—	—	—	—	—	—	2,121	1,362
Export Duty on Scheelite .. .	—	—	—	—	—	—	—	—	—	—	—	81
Export Duty on Ilmenite .. .	1,356	—	—	—	—	—	—	—	—	—	1,356	1,308
Export Duty on Iron-ore .. .	b. 28,153	—	—	—	—	—	—	—	—	—	28,153	78
Export Duty on Kaolin .. .	24	—	—	—	—	—	—	—	—	—	24	84
Royalty on Gold	—	4,723	880	—	27,560	—	—	—	—	—	33,163	13,615
Commutated Royalty on Gold .. .	—	—	—	—	—	—	—	—	—	—	—	125
Royalty on Coal	—	—	87,021	—	—	—	—	—	—	—	87,021	79,842
Total	29,461,343	4,723	87,901	—	27,560	—	—	—	—	—	29,531,527	13,558,374
GRAND TOTAL	29,462,468	253,021	279,109	38,884	60,162	15,304	17,519	15,385	2,218	677	30,144,747	14,016,698

a. Royalty on Coal for 1947 amounted to \$79,842 and was paid in 1948.

b. Includes \$27,812 being export duty on 70,546 tons of iron-ore from stock-pile.

(b) *Machinery Branch.*—In the year under review the total revenue was approximately \$79,300, showing an increase over 1947 of \$27,440 or 54 per cent. Details of revenue received are as shown in Table 50.

This revenue is credited to the States/Settlements in which the services are rendered.

The work done by the Headquarters office, which is considerable, is not revenue producing.

TABLE 50.

Mines Department Revenue, 1948.

Total Revenue from Sources connected with Machinery.

Sources.	Perak.	Selangor.	Negri Sembilan.	Johore.	Malacca.	Penang.	Kedah.	Total, 1948.	Total, 1947.
	\$	\$	\$	\$	\$	\$	\$	\$	\$
MACHINERY OFFICE.									
Survey of Prime Movers, etc. . .	28,135	15,935	2,905	7,565	345	2,775	1,285	58,945	37,454
Survey of Installations	4,775	3,100	670	1,100	120	1,620	—	11,385	7,960
Examination Fees	3,241	2,665	294	1,264	286	910	132	8,792	6,376
Miscellaneous Receipts	54	8	—	92	—	23	—	177	70
Total	36,205	21,708	3,869	10,021	751	5,328	1,417	79,299	51,860

45. DEPARTMENTAL EXPENDITURE.—(a) *Mines, Mineral Ores and Statistical Branches.*—The total expenditure during the year under review for the Mines Department and its Branches, excluding the Machinery Branch, amounted to \$970,878, and is shown, as classified, in Table 51.

The increase in expenditure for 1948 in comparison with 1947 was approximately 41 per cent. This increase was due to an upward revision of salaries as a result of the Public Services Salaries Commission's findings; the higher rates of cost of living allowance; the grant of expatriation pay and an increase in the contribution to the International Tin Research and Development Council and the Tin Research Institute from £20,000 for 1947 to £28,000 for 1948.

The opening of all offices has not been completed owing to the inability to recruit suitably qualified staff, but during the year under review an Inspector of Mines office was opened in Trengganu at Kemaman.

(b) *Machinery Branch.*—The total expenditure during the year under review for the Machinery Branch amounted to \$149,698, and is shown, as classified, in Table 51.

The increase over the expenditure for 1947 was due to the upward revision of salaries as a result of the Public Services Salaries Commission's findings; the higher rates of cost of living allowance and the grant of expatriation pay.

An office at Seremban was opened during the year, but owing to shortage of staff it has not been possible during the year under review to open offices at Taiping, Tapah, Kuantan and Muar.

TABLE 51.
Departmental Expenditure, 1948.

Expenditure Detailed.	Head- quarters.	Perak.	Selangor.	Negri Sembilan and Malacca.	Pahang.	Johore.	Trengganu.	Kedah and Perlis.	Penang.	Total, 1948.	Total, 1947.
	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
MINES DEPARTMENT.											
Personal Emoluments ..	80,113	136,153	67,017	24,979	27,458	26,873	7,983	15,375	—	385,956	293,706
Annually Recurrent ..	14,731	37,890	19,160	5,302	6,888	7,124	2,957	4,521	—	99,073	84,205
Special Expenditure ..	4,862	4,778	594	—	—	—	906	463	—	11,603	21,961
Miscellaneous Services ..	47,100	78,945	44,118	13,771	14,861	15,501	6,639	8,022	—	223,957	110,598
	146,806	257,766	130,889	44,552	49,207	49,498	18,490	28,381	—	725,589	510,470
Expenses towards the Inter- national Tin Study Group ..	5,289	—	—	—	—	—	—	—	—	5,289	4,115
Contribution to the Inter- national Tin Research and Development Council and Tin Research Institute ..	240,000	—	—	—	—	—	—	—	—	240,000	^a 171,429
Total Mines ..	392,005	257,766	130,889	44,552	49,207	49,498	18,490	28,381	—	970,878	686,014
MACHINERY BRANCH.											
Personal Emoluments ..	14,125	26,710	15,747	4,878	—	8,732	—	—	9,092	79,284	58,302
Annually Recurrent ..	3,070	7,579	3,028	1,737	—	3,391	—	—	410	19,215	11,644
Special Expenditure ..	2,618	—	—	—	—	—	—	—	—	2,618	2,230
Miscellaneous Services ..	7,997	16,919	8,980	3,676	—	6,401	—	—	4,608	48,581	^b —
Total Machinery ..	27,810	51,208	27,755	10,291	—	18,524	—	—	14,110	149,698	72,176
GRAND TOTAL ..	419,905	308,974	158,644	54,843	49,207	68,022	18,490	28,381	14,110	1,120,576	758,190
SUMMARY.											
Personal Emoluments ..	94,238	162,863	82,764	29,857	27,458	35,605	7,988	15,375	9,092	465,240	352,008
Annually Recurrent ..	17,801	45,469	22,185	7,539	6,888	10,515	2,957	4,521	410	118,288	95,849
Special Expenditure ..	7,480	4,778	594	—	—	—	906	463	—	14,221	24,191
Miscellaneous Services ..	55,097	95,864	53,093	17,447	14,861	21,902	6,639	8,022	4,608	277,538	^b 110,598

^a. The contribution paid for the year 1947 was \$171,428.57 (£20,000).
1947 in respect of the Machinery Branch not included.

^b. Children's Cost of Living and Rent Allowances expended under the Public Works Department during

46. EXPORT DUTIES AND ROYALTIES ON MINERALS:

1. TIN-ORE—

- (i) When the price of tin does not exceed \$41 (per picul) ... \$2.40 per picul.
- (ii) When the price of tin exceeds \$41 but does not exceed \$42 \$2.52 per picul.
- (iii) When the price of tin exceeds \$42 but does not exceed \$43 and so on, the duty per picul being increased by 12 cents per every dollar by which price of tin exceeds \$41 \$2.64 per picul.
- (iv) Tin, smelted or manufactured from tin-ore won in the Federation of Malaya unless smelted in the free port of Penang ... On the same scale as that for tin-ore, together with an additional duty of one-third of the duty on tin-ore.
- (v) Tin slag and hard-head of tin ... At the rate prescribed for tin-ore, unless the consignment is accompanied by a certificate of assay granted by the Government Geologist or approved by the Senior Inspector of Mines, in which case the duty shall be at the rate prescribed for tin smelted or manufactured on the amount of tin estimated to be contained in such consignment.
- *(vi) To be smelted elsewhere than in Singapore or the free port of Penang In the case of tin-ore exported otherwise than under such guarantees as the High Commissioner may require that it shall be smelted in Australia or the United Kingdom, an additional duty of \$30 per picul.

2. SCHEELITE AND WOLFRAM ... \$2 per picul.

* Deleted from Table B, Export Duties III (a) on 30th June, 1948.

3. GOLD ... 5 per cent. *ad valorem* at \$66 per oz. *vide* G.N. 4414 of 1939 (F.M.S.).
4. COAL ... 25 cents per ton.
5. CHINA CLAY OR KAOLIN ... 75 cents per ton.
6. OTHER METALS AND METAL-LIFEROUS ORES ... 10 per cent. *ad valorem*.

47. PROSECUTIONS.—The particulars of cases heard in the Magistrates' courts under the Mining and Associated Enactments are tabulated in the following Table:

TABLE 52.

Year.	No. of cases.	Convictions.	Dismissals.	Persons concerned.	Persons convicted.	Fines paid.
1939*..	92	88	4	119	115	2,669
1946 ..	79†	79	—	188	188	5,745
1947 ..	18	16	2	46	34	2,554

1948.

States.	No. of cases.	No. of convictions.	No. of dismissals.	No. of persons concerned.	No. of persons convicted.	No. of persons imprisoned.	Fines paid.
							\$ c.
Perak	6	5	1	7	5	—	870 00
Selangor	27	23	4	48	41	—	4,850 00
Negri Sembilan	18	18	—	18	18	—	2,110 00
Pahang	1	1	—	1	1	—	250 00
Johore	1	1	—	1	1	—	58 00
Trengganu	—	—	—	—	—	—	—
Kedah	—	—	—	—	—	—	—
Perlis	1	—	1	3	—	—	—
Kelantan	—	—	—	—	—	—	—
Malacca	—	—	—	—	—	—	—
Total	54	48	6	78	66	—	8,138 00

* Details are not available but most of these cases were heard in the Court of the Senior Inspector of Mines. † All these cases were in respect of illegal mining.

48. NEW LEGISLATION.—The following new legislation was passed during the year:

- (i) *Transfer of Powers Ordinance No. 1/48.*—The powers delegated to the Resident under the Mining and Allied Enactments have been transferred to the Ruler-in-Council, Mentri Besar and the Chief Secretary, *vide* Federal Gazette No. 250 dated 6th March, 1948.
- (ii) *Transfer of Powers Ordinance No. 1/48.*—The Labour Code (Cap. 154)—The provisions of Part IX of the Labour Code (Cap. 154) to be complied with by the owner, lessee or occupier thereof and shall apply to all mines in the State of Perak, *vide* Federal Gazette No. 887 dated 29th April, 1948.

- (iii) *The Customs Proclamation*.—The Customs Duties (No. 17) Order—Amendment of the Order by the deletion of the following words from Table B, Export Duties III (a): with effect from 30th June, 1948—

"In the case of tin-ore exported otherwise than under such guarantees as the High Commissioner may require that it shall be smelted in the Straits Settlements, Australia or the United Kingdom, an additional duty of \$30 per picul".

Federal Gazette Notification No. 1704 dated 1st July, 1948.

- (iv) *The Emergency Regulations Ordinance, 1948*.—The appointment of Mr. J. Sanderson, Acting Senior Inspector of Mines, Perak, Federation of Malaya, to carry on the whole undertaking of the Sin Tong Fatt Tin Mine, Kampar, Perak, in accordance with the provisions of paragraphs (1) (c) and (2) of Regulation 19 of the Emergency Regulations, 1948, and with such instructions as may, from time to time, be given by the High Commissioner, with effect from 17th July, 1948; Federal Gazette No. 2039.

PART XIII.

CONCLUSION.

49. CONCLUSION AND FUTURE OUTLOOK.—The Mining Industry has continued with the heavy task of rehabilitation throughout 1948, but without achieving the progress which was anticipated at the beginning of the year. In view of the difficulties met with, the degree of rehabilitation attained has, however, been very commendable. Recovery continued to be greatly aided by the substantial loans granted by Government to the Industry during the previous years and in 1948.

Mining costs shewed no tendency to fall, and the cost of labour continued to be high. Prices of materials, supplies and fuel continued at a high level, and in some cases difficulties were experienced in obtaining engineering supplies, especially electrical items and structural steel. Delivery dates shewed some improvement, but were still subject to disappointing delays and postponements. Fortunately no shortage of fuels was experienced; coal, oil and wood supplies were generally sufficient for all purposes.

Production of tin-ore increased from a total production of 606,130 piculs at the end of December, 1947, to 1,003,869 piculs at the end of 1948, and the number of working mines increased from 488 units in December, 1947, to 633 units in December, 1948.

This is particularly commendable in view of the state of Emergency which has existed since mid-year.

It is feared that unless greater security is obtained for the supervisory staff on mines, who have during the past six months lived under a continual strain, it is inevitable that a falling off of efficiency will result, which will have its effect on production. Both the country and the mine-owners owe much to the staff on the mines for their loyalty and steadfastness. Had this faltered the situation would have been most serious, and the terrorists would undoubtedly have achieved some of the results they had hoped for.

The future continuance of the Mining Industry in this country depends entirely upon whether mineral bearing areas are made available for prospecting. It is necessary to do much prospecting work, as a large proportion of this often proves unproductive, in order to prove reserves of workable ground, and much time is required for this to be done. If Malaya is not to revert to the low standard of living of a purely agricultural country its mines must continue to produce. For about 17 years the acquisition of new mining areas by the Industry has been at a very much lower rate than has the exhaustion by mining.

It would appear that within the next few years there may be an appreciable drop in production due to the fact that there is no longer enough land to be mined to maintain production. The alternative is to release more land for mining, not only to replace worked out areas, but also to create reserves without which no capital will be attracted.

The outlook for 1949 is sombre owing to the dark clouds caused by terrorism and its effects on mining, both present and potential. If this situation is quickly cleared the immediate outlook will be hopeful, as many of the problems confronting the Industry have been surmounted. The present price of tin is an incentive to expansion and further production, and shortages of power have been largely overcome. A further improvement would be shown by an all round reduction in the cost of mining, supplies and foodstuffs.

I wish to express my thanks to the F.M.S. Chamber of Mines and the All-Malayan Chinese Mining Association and its branches for the ready co-operation and confidence which has existed throughout a difficult and strenuous year. The co-operation of the Geological Department and its officers during 1948 is also acknowledged.

It is hoped that the Emergency which existed at the end of 1948 will come to a speedy end early in 1949, and that the Mining Industry will be able to complete its full programme of Rehabilitation.

KUALA LUMPUR,
1st April, 1949.

A. BEAN, A.C.S.M., M.I.M.M.,
Chief Inspector of Mines,
Federation of Malaya.

APPENDIX I.

SHORT HISTORY OF INTERNATIONAL TIN CONTROL, 1931-1946.

The first International Control Scheme was signed in February, 1931, and was administered by an International Committee composed of delegates from the four Signatory Governments, Malaya, Bolivia, Netherlands East Indies and Nigeria.

2. The introduction of this control was due to the unhealthy state of the Tin Market caused by excess production over consumption during the previous years—this is illustrated by the following figures:

Year.	World's Production.	Visible Stocks and carry over.	World's Consumption.	Average Price Sterling.
1924 ...	141,500	19,495	—	248.9
1925 ...	146,100	18,616	—	261.1
1926 ...	143,400	14,868	—	291.2
1927 ...	158,900	16,035	150,900	289.1
1928 ...	177,900	19,588	170,600	227.2
1929 ...	192,600	27,229	183,600	203.9
1930 ...	176,000	42,158	168,000	142.0
1931 ...	148,900	55,370	140,500	118.5

(Figures taken from the Statistical Year Book, 1939, of the International Tin Research and Development Council.)

3. The four participating Governments adopted for the 1st Agreement, as the world's production in 1929 the following figures:

Malaya	...	69,366 tons (long) tin
Nigeria	...	10,734 ..
Bolivia	...	46,338 ..
N.E.I.	...	35,730 ..
Siam	...	10,000 ..
Total	...	172,168

4. The Table A shows the standard tonnages (meaning the annual rate of permissible export of metallic tin when the quota is 100 per cent.) allocated under the various agreements.

TABLE A.

STANDARD TONNAGES UNDER THE INTERNATIONAL TIN CONTROL SCHEME. (Long Tons).

	1ST AGREEMENT.	2ND AGREEMENT.		3RD AGREEMENT.		4TH AGREEMENT.
	March 1, 1931, to December 31, 1933.	January 1, 1934, to December 31, 1936.		January 1, 1937, to June 30, 1938.	July 1, 1938, to December 31, 1941.	January 1, 1942, to December 31, 1946.
	Standard tonnages.	Standard tonnages.		Standard tonnages.	Standard tonnages.	Standard tonnages.
Bolivia	46,338	46,490		46,490	46,490	46,768
Malaya	69,366	71,940		71,940	77,335	95,474
Netherlands East Indies ..	35,730	36,330		36,330	39,055	55,113
Nigeria	10,734	10,890		10,890	10,890	15,367
	Flat rate as from September 1, 1931.	Flat rates. 1934. 1935. 1936.				
Belgian Congo	—	4,500	6,000	7,000	13,200	20,178
Siam	10,000	9,800	9,800	9,800	18,000	18,000(?)
Cornwall	—	1,700	1,700	1,700	—	—
French Indo-China	—	1,700	2,500	3,000	3,000	3,000 (?)
Portugal	—	650	650	650	—	—
Total Standard Tonnages ..	162,168	165,650			199,850	253,900
Standard Tonnages + Flat Rates	172,168	184,000	186,300	187,800	199,850	253,900

The 1st Agreement was signed in February, 1931, and expired on 31st December, 1933.

The 2nd Agreement which was signed in October, 1933, came into force on 1st January, 1934, and was for a period of three years. It was administered by the four original participating countries (Malaya, Nigeria, Bolivia and Netherlands East Indies) and Siam, which Committee was known as the International Tin Committee.

The 3rd Agreement came into operation on 1st January, 1937, and did not expire until 31st December, 1941.

(Figures in the Table taken from the Statistical Year Book, 1939, of the International Tin Research and Development Council, and from its Statistical Bulletin of January, 1947).

It will be seen that whilst the standard tonnages of the four original signatory countries (Malaya, Nigeria, Bolivia and Netherlands East Indies) were the same in the Second and Third Agreements and approximately representative of their 1929 production, the standard tonnages allotted to Belgian Congo, French Indo-China and Siam in the Third Agreement were greatly in excess of their 1929 production which was :

Belgian Congo	1,011 tons (long) tin
French Indo-China	829 ..
Siam	9,939 ..

These three countries adhere to the International Tin Control Scheme only on condition that their minimum standard tonnage should be raised to that as shown in the Third Agreement, Table A. The price of inducing other countries to participate in the scheme thus resulted in penalizing the four original signatory Governments.

The Fourth Agreement came into operation on 1st January, 1942, and expired on 31st December, 1946, but with the occupation of Malaya, Netherlands East Indies, French Indo-China and Burma by the Japanese, production of tin was considerably reduced, and to all intent and purpose restriction of production was therefore unnecessary and not enforced.

It will be noticed in Table B that Bolivia has defaulted in production practically throughout the period of Restriction.

5. An International Committee was formed to administer the scheme, and for the First and Second Agreements, the Committee consisted of the four participating countries only, and all questions were decided by an unanimous vote.

In the Third Agreement this Committee was modified, each delegation voted as a unit, the number of votes allotted being :

Malaya	5
Bolivia	4
Netherlands East Indies	4
Siam	2
Belgian Congo	2
Nigeria	2
French Indo-China	1

The voting power was not allotted under a producing tonnage basis.

6. The method of operating these schemes was to fix a quota based on standard tonnages, the situation was reviewed once a quarter, and more frequently if necessary, by the International Committee and to change the quotas each quarter if it was found essential. These decisions would depend upon the balance between production and consumption, the Committee being guided partly by variation in price and partly by statistics of stocks. With increase of stocks and a resulting fall in price, the quota production would be reduced and on a decrease in stocks with an increase in price, quotas would be increased.

TABLE B.

INTERNATIONAL EXPORTS COMPARED WITH QUOTAS.

LONG TONS.

	Quota.	Export.		Over-export (+) or under-export (-).		Export.		Over-export (+) or under-export (-).	
		Permis- sible.	Actual.	During period.	Cumulative total.	Permis- sible.	Actual.	During period.	Cumulative total.
BELGIAN CONGO.									
1931 ..	69.1	—	—	—	—	25,380	25,518	+ 138	+ 138
1932 ..	43.7	—	—	—	—	19,267	20,583	+ 1,316	+ 1,454
1933 ..	33.3	—	—	—	—	14,687	14,725	+ 38	+ 1,492
1934 ..	45.0	4,500	4,602	+ 102	+ 102	20,988	20,634	- 354	- 354
1935 ..	58.8	6,125	6,481	+ 356	+ 458	27,313	24,880	- 2,433	- 2,787
1936 ..	92.5	7,687	7,310	- 377	- 81	39,516	24,074	- 15,442	- 3,293
1937 ..	107.5	11,834	8,856	- 2,978	- 363	40,397	25,024	- 24,373	- 1,544
1938 ..	53.8	6,399	7,316	+ 917	+ 554	21,917	25,371	+ 3,454	+ 1,910
1939 ..	761	9,884	9,663	- 221	- 335	34,944	27,215	- 7,729	- 2,912
1940 ..	115.0	16,140	12,377	- 3,763	- 1,345	52,931	37,940	- 14,991	- 4,411
1941 ..	130.0	19,546	14,122	- 5,424	- 1,629	59,835	42,050	- 17,785	- 4,986
1942 ..	105.0	21,187	13,072	- 8,115	- 1,766	49,106	38,291	- 10,815	- 4,092
1943 ..	105.0	21,187	16,833	- 4,354	- 1,766	49,106	41,523	- 7,583	- 4,092
1944 ..	105.0	21,187	17,146	- 4,041	- 1,766	49,106	38,309	- 10,797	- 4,092
1945 ..	105.0	21,187	15,964	- 5,223	- 1,766	49,106	42,483	- 6,623	- 4,092
BOLIVIA.									
1931 ..	69.1	—	—	—	—	39,947	41,486	+ 1,539	+ 1,539
1932 ..	43.7	—	—	—	—	30,323	28,408	- 1,915	- 376
1933 ..	33.3	—	—	—	—	23,115	23,760	+ 645	+ 269
1934 ..	45.0	1,700	1,070	- 630	- 630	34,220	34,059	- 161	- 161
1935 ..	58.8	2,500	1,421	- 1,079	- 1,079	42,265	42,358	+ 93	+ 68
1936 ..	92.5	3,000	1,409	- 1,591	- 0	66,544	66,806	+ 262	+ 194
1937 ..	107.5	3,225	1,531	- 1,694	- 101	77,335	77,542	+ 207	+ 401
1938 ..	53.8	1,967	1,575	- 392	- 226	42,973	43,247	+ 274	+ 675
1939 ..	761	2,625	1,392	- 1,233	- 219	58,968	56,001	- 2,967	- 2,292
1940 ..	115.0	3,450	1,560	- 1,890	- 287	88,935	85,384	- 3,551	- 5,732
1941 ..	130.0	3,900	1,560	- 2,340	- 325	92,158	74,367	- 17,791	- 23,523
FRENCH INDO-CHINA.									
1931 ..	69.1	—	—	—	—	5,925	6,036	+ 111	+ 111
1932 ..	43.7	—	—	—	—	4,499	4,174	- 325	- 214
1933 ..	33.3	—	—	—	—	3,431	3,651	+ 220	+ 6
1934 ..	45.0	18,189	18,678	+ 489	+ 489	5,015	4,990	- 25	- 19
1935 ..	58.8	21,344	22,003	+ 1,559	+ 2,048	6,398	6,484	+ 86	+ 67
1936 ..	92.5	33,605	31,684	- 1,921	- 127	10,073	9,634	- 439	- 372
1937 ..	107.5	39,055	39,825	+ 770	+ 897	11,707	10,468	- 1,239	- 976
1938 ..	53.8	21,702	21,024	- 678	- 219	6,321	7,305	+ 984	+ 8
1939 ..	761	29,779	31,410	+ 1,631	+ 1,850	8,304	10,855	+ 2,551	+ 2,567
1940 ..	115.0	44,914	44,503	- 411	- 1,499	12,524	10,257	- 2,267	- 300
1941 ..	130.0	46,541	48,805	+ 2,264	+ 3,763	14,157	14,999	+ 842	+ 1,142
1942 ..	105.0	—	—	—	—	16,135	12,000	- 4,135	- 1,345
1943 ..	105.0	—	—	—	—	16,135	12,670	- 3,465	- 1,345
1944 ..	105.0	—	—	—	—	16,135	13,149	- 2,986	- 1,345
1945 ..	105.0	—	—	—	—	16,135	11,028	- 5,107	- 1,345
NETHERLANDS EAST INDIES.									
1931 ..	69.1	22,157	22,169	+ 12	+ 12	5,925	6,036	+ 111	+ 111
1932 ..	43.7	16,820	15,427	- 1,393	- 1,381	4,499	4,174	- 325	- 214
1933 ..	33.3	12,823	14,181	+ 1,358	+ 23	3,431	3,651	+ 220	+ 6
1934 ..	45.0	18,189	18,678	+ 489	+ 489	5,015	4,990	- 25	- 19
1935 ..	58.8	21,344	22,003	+ 1,559	+ 2,048	6,398	6,484	+ 86	+ 67
1936 ..	92.5	33,605	31,684	- 1,921	- 127	10,073	9,634	- 439	- 372
1937 ..	107.5	39,055	39,825	+ 770	+ 897	11,707	10,468	- 1,239	- 976
1938 ..	53.8	21,702	21,024	- 678	- 219	6,321	7,305	+ 984	+ 8
1939 ..	761	29,779	31,410	+ 1,631	+ 1,850	8,304	10,855	+ 2,551	+ 2,567
1940 ..	115.0	44,914	44,503	- 411	- 1,499	12,524	10,257	- 2,267	- 300
1941 ..	130.0	46,541	48,805	+ 2,264	+ 3,763	14,157	14,999	+ 842	+ 1,142
1942 ..	105.0	—	—	—	—	16,135	12,000	- 4,135	- 1,345
1943 ..	105.0	—	—	—	—	16,135	12,670	- 3,465	- 1,345
1944 ..	105.0	—	—	—	—	16,135	13,149	- 2,986	- 1,345
1945 ..	105.0	—	—	—	—	16,135	11,028	- 5,107	- 1,345
THAILAND.									
1931 ..	69.1	3,333	3,508	+ 175	+ 175	96,742	98,717	+ 1,975	+ 1,975
1932 ..	43.7	10,000	9,261	- 739	- 564	80,909	77,853	- 3,056	- 1,081
1933 ..	33.3	10,000	10,324	+ 324	+ 240	64,056	66,641	+ 2,585	+ 240
1934 ..	45.0	9,900	10,587	+ 687	+ 547	96,954	95,838	- 1,116	- 604
1935 ..	58.8	10,290	9,779	- 511	- 36	118,715	116,306	- 2,409	- 241
1936 ..	92.5	12,495	12,678	+ 183	+ 219	176,079	155,818	- 20,261	- 3,044
1937 ..	107.5	20,136	16,494	- 3,642	- 1,678	212,689	179,740	- 32,949	- 3,364
1938 ..	53.8	12,558	13,520	+ 962	+ 716	113,837	119,358	+ 5,521	+ 2,424
1939 ..	761	16,299	16,970	+ 671	+ 45	160,803	153,606	- 7,197	- 716
1940 ..	115.0	21,410	17,447	- 3,963	- 1,784	240,315	209,528	- 30,787	- 11,760
1941 ..	130.0	24,216	15,247	- 8,969	- 2,018	272,962	—	—	—
TOTAL.									

TABLE C.

INTERNATIONAL QUOTAS RELEASED DURING
RESTRICTION.

Year.	Jan.-Mar. Per cent.	Apr.-May. Per cent.	June-Sept. Per cent.	Oct.-Dec. Per cent.
1931 ...	77	77	65.4	65.4
1932 ...	56.2	56.2	33.3	33.3
1933 ...	33.3	33.3	33.3	33.3
1934 ...	40	50	50	40
1935 ...	40	45	70	80
1936 ...	90	85	90	105
1937 ...	100	110	110	110
1938 ...	70	62.56*	35†	35†
1939 ...	35†	40	120	100
1940 ...	120	80	130	130
1941 ...	130	130	130	130

The great difficulty was that quotas could not be changed more frequently than once a quarter, thus extra tin could not be forthcoming quickly when required. Similarly with periods of depression the reduction in production would not be sufficiently rapid, without causing dislocation of mining, labour troubles, etc.

To overcome this difficulty the Tin Buffer Stock Schemes were introduced.

7. The principles of the Tin Buffer Stock Scheme were that a duly authorised Committee should build up a stock of stated dimensions by contributions from the participating countries to the Agreement in proportion to their standard tonnage. With such a stock, tin was available for immediate sale if and when the demand should arise, and would provide a refuge for unwanted tin when prices fell, by the Committee buying in stocks of tin. The tin thus held would be sold only in accordance with the scheme. Agreement for the first official Tin Buffer Stock Scheme was dated July, 1934, and constituted a buffer stock of 8,282 tons tin; this scheme was wound up at the end of 1935 with profit to the contributory countries. A further Buffer Stock Scheme was agreed upon in June, 1938, the initial stock was to consist of 10,000 tons tin with a provision for a subsequent increase to 15,000 tons tin. The amount contributed was 15,512 tons tin. The Scheme provided also for the purchase of tin from the open market and the total purchases and sales by the Committee amounted to 66,428 tons tin, and the net price realised was £230 16s. 11d.

8. At this stage it seems appropriate to refer to the following Table D when comparisons can be made between price, production, stocks, etc., in relation to the International Tin Control Scheme.

* Includes 7.56 per cent. to Malaya on account of Bolivia's under-production in 1937. † Buffer stock 10 per cent.

TABLE D.

TIN LONG TONS.

Year.	World's Production.	Visible stocks plus carry over.	World's Consumption.	Average Price Sterling.
1929 ...	192,600 ...	27,229 ...	183,600 ...	203.9
1930 ...	176,000 ...	42,158 ...	168,000 ...	142.0
1931 ...	148,900 ...	55,370 ...	140,500 ...	118.5
1932 ...	99,200 ...	58,427 ...	104,600 ...	135.9
1933 ...	91,000 ...	44,407 ...	132,500 ...	194.6
1934 ...	115,200 ...	Not known ...	123,100 ...	230.4
1935 ...	138,000 ...	Not known ...	149,200 ...	225.7
1936 ...	179,000 ...	44,300 ...	154,900 ...	204.6
1937 ...	207,500 ...	60,000 ...	185,200 ...	242.3
1938 ...	160,000 ...	69,500 ...	148,600 ...	189.6
1939 ...	167,000 ...	73,800 ...	158,100 ...	226.3
1940 ...	231,500 ...	123,700 ...	158,200 ...	256.6
1941 ...	239,000 ...	180,600 ...	169,400 ...	261.6
1942 ...	119,500 ...	165,300 ...	114,900 ...	276.5
1943 ...	138,500 ...	160,100 ...	101,500 ...	276.5

(Figures taken from the Statistical Year Book, 1939, of the International Tin Research and Development Council, and from the Statistical Bulletin, April, 1949, of the International Tin Study Group.)

The visible stocks plus carry over in Table D include—

Stocks tin-in-ore.

Tin-in-ore afloat.

Stocks of tin metal.

Tin metal afloat.

Visible consumers stock of tin metal.

9. Control of production in Malaya involved allotting an assessment to each concession or mine in accordance with its performance in 1929 and/or 1930, and its estimated production in the future based on the equipment installed. Many new mines especially dredging concerns were in process of increasing their productive capacity by installing new equipment, consequently when the local assessments were totalled a figure was reached considerably in excess of the International Standard tonnage based upon the 1929 production. The Malayan Internal Assessment was found to be 101,430 tons tin as compared with the International Standard Tonnages of 69,366 tons tin. Thus it will be seen why the Malayan Internal quota release (or Domestic Release) was lower than the International Quota Release—the following table shows the Quotas:

TABLE E.
QUOTA RELEASE IN PERCENTAGES.

Year.	January-March.	April-May.	June-September.	October-December
1931	I.R. ← 77 →	← ————— →	← —————	65.4 →
	M.R. ← 75	—————→	← 75 Aug. Sept.-Dec. 40 →	
1932	I.R. ← 56.2	—————→	← ————— June-July	33.8 →
	M.R. ← 40	—————→	33.8 ← ————— 25 →	
1933	I.R. ← 33.3	—————→	—————→	—————→
	M.R. ← 25 →	← 23 —————→	June, July to Dec. ← ————— 25 →	
1934	I.R. ← 40 →	← 50 →	← 50 →	← 40 →
	M.R. ← 31 →	← 37.5 —————→	—————→	← 30 →
1935	I.R. ← 40 →	← 45 →	← 70 →	← 80 →
	M.R. ← 28.3 →	← 32.4 →	← 46.7 →	← 62 →
1936	I.R. ← 90 →	← 85 →	← 90 →	← 105 →
	M.R. ← 65 →	← 62 →	← 65 →	← 76 →
1937	I.R. ← 100 →	← —————→	—————→	110 →
	M.R. ← 72 →	← 79 →	← 80 —————→	
1938	I.R. ← 70 →	← 62.56* →	← 35 → Buffer Stock 10%	← 35 →
	M.R. ← 56 →	← 43 →	← 25.5 → Buffer Stock 7.6%	← 25 →
1939	I.R. ← 35 → Buffer Stock 10%	← 40 →	← 120 →	← 100 →
	M.R. ← 25 → Buffer Stock 7.5%	← 28.5 →	← 71 →	← 80 →
1940	I.R. ← 120 →	← 80 →	← 130 →	← 130 →
	M.R. ← 90 →	← 65 →	← 100 —————→	
1941	I.R. ← —————→	130 —————→	—————→	—————→
	M.R. ← —————→	100 —————→	—————→	—————→

* Includes 7.56 per cent. to Malaya on account of Bolivia's under-production in 1937.

I.R. means—International Quota Release.

M.R. means—Malayan Domestic or Internal Quota Release.

The following Table F shows the yearly production in Malaya from 1929 to September 30, 1941:

TABLE F.
MALAYAN PRODUCTION.

TIN-IN-ORE—LONG TONS.					
1929	...	...	...	...	69,999
1930	...	...	...	...	64,983
1931	...	...	...	...	53,115
1932	...	...	...	...	27,827
1933	...	...	...	...	23,893
1934	...	...	...	...	36,214
1935	...	...	...	...	40,791
1936	...	...	...	...	64,682
1937	...	...	...	...	75,118
1938	...	...	...	...	41,205
1939	...	...	...	...	44,627
1940	...	...	...	...	80,651
1941 (9 months only)	...	...	...	...	60,292

At the commencement of restriction the standard tonnage of Malaya was fixed at 69,366 tons of tin, based on an assay value of 72 per cent. tin-in-ore; the true assay value was taken as 75.5 per cent. tin-in-ore.

10. During 1937 Malaya and Netherlands East Indies were the only countries participating in the Control Scheme able to produce their permissible quotas, the International quota that year being 100 per cent. Bolivia was unable to produce its quota practically throughout the whole period of restriction. Table B shows the production as compared with International quota.

The difficulty caused by Bolivia's failure in 1937 to produce her quota, was partly overcome by allotting a part of her under-production to Malaya and Netherlands East Indies.

Malaya with its numerous mines suffered unduly heavily when there was a low percentage quota release.

Siam and French Indo-China were working with a fixed minimum tonnage, and thereby did not suffer so badly as Malaya. In 1931 Malaya produced 54,908 tons tin-in-ore or 36.8 per cent. of the world's total, but in 1933 when the International quota was only 33½ per cent. Malaya's production was reduced to 24,904 tons tin-in-ore forming 27.3 per cent. of world's production, which would tend to show that the International Tonnage allotted to Malaya was on the low side.

Siam, China and Belgian Congo increased their production greatly during the years of restriction as will be seen in Table B.

11. The figures of production from the various countries during 1942-1946 do not present a true picture of their normal productive capacity. With the occupation of the Far East countries by the Japanese, the world's production was seriously affected and the remaining producing countries made an all-out effort to increase their production to supply the tin so badly needed for the prosecution of the war.

APPENDIX II.

PROGRESS IN NUMBER OF UNITS PRODUCING IN TIN MINES.

Type.	1941.	As at 31-12-47.	1948.												Storke Report Estimate.
			Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
Dredges	103	56	57	59	61	62	63	61	65	65	67	67	67	67	104
Gravel Pump Mines ..	668	323	339	344	356	363	372	393	412	430	436	447	462	464	483
Hydraulic Mines ..	31	24	23	23	22	23	22	21	22	23	23	22	20	22	31
Open-cast Mines ..	17	10	10	9	9	10	10	10	6	6	7	7	7	8	17
Miscellaneous	10	27	22	23	25	22	25	29	30	33	32	32	35	33	10
Small Workings (no machinery)	133	48	43	46	45	47	47	46	41	39	42	42	41	39	—
Total ..	962	488	494	504	518	527	539	560	567	596	607	617	632	633	645

APPENDIX III.

PRODUCTION STATISTICS TO 31st DECEMBER, 1948.

TONS, TIN-IN-ORE @ 75 PER CENT.

Sources.	1941 monthly average.	Total 1947.	Dec., 1947.	1948.												Total 1948.	Storke Report Estimate, 1948.
				Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.		
From Dredges (Not Companies)	3,408	12,326	1,729	1,682	1,541	1,773	1,774	1,874	1,664	1,912	1,964	1,823	1,976	1,977	1,969	21,934	30,800
.. Gravel Pump Mines	2,411	8,827	1,143	1,190	1,013	1,209	1,282	1,345	1,375	1,425	1,490	1,446	1,426	1,517	1,589	16,256	17,000
.. Open Cast Mines	268	324	39	56	52	24	41	58	28	45	39	47	44	60	65	559	3,100
.. Underground Mines	252	690	89	88	69	80	88	84	98	94	94	115	117	142	156	1,225	2,700
.. Hydraulic Mines	251	1,546	159	174	168	188	196	189	182	180	171	174	183	175	212	2,192	9,000
.. Miscellaneous	6	1,045	101	18	18	16	14	19	17	16	14	22	22	28	31	235	
.. Dulong Washing	103	1,768	140	173	142	161	173	190	208	198	203	224	243	253	246	2,414	1,200
Total ..	6,699	27,026	3,400	3,381	3,002	3,456	3,518	3,759	3,572	3,870	3,975	3,851	4,011	4,152	4,268	44,815	
From European Mines	4,732	16,172	2,063	2,014	1,866	2,101	2,134	2,242	2,011	2,268	2,292	2,150	2,300	2,317	2,338	26,033	
.. Chinese Mines	1,857	9,091	1,197	1,194	994	1,194	1,211	1,327	1,353	1,404	1,480	1,477	1,463	1,532	1,684	16,368	
.. Other Sources	110	1,763	140	173	142	161	173	190	208	198	203	224	243	253	246	2,414	
Total ..	6,699	27,026	3,400	3,381	3,002	3,456	3,518	3,759	3,572	3,870	3,975	3,851	4,011	4,152	4,268	44,815	

APPENDIX IV.

WORLD'S PRODUCTION OF TIN-INOSE.

LONG TONS.

Year.	Belgian Congo.	Nigeria.	Bolivia.	Burma.	China.	French Indo-China.	Malaya.	N.E.I.	Siam.	United Kingdom.	Other Countries.	World.
1935 ..	5,301	6,557	27,168	4,636	9,398	1,310	42,375	20,135	9,878	2,050	9,200	138,000
1936 ..	5,301	9,738	24,074	5,134	10,664	1,381	66,769	30,729	12,678	2,099	9,600	179,000
1937 ..	8,942	10,782	25,025	5,290	10,457	1,577	77,266	39,134	16,484	1,943	10,600	207,500
1938 ..	8,920	8,977	25,371	5,014	11,246	1,506	43,375	27,208	14,704	2,010	11,400	160,000
1939 ..	8,964	9,428	27,215	5,441	10,859	1,260	47,416	27,809	16,970	1,632	10,600	167,000
1940 ..	12,482	12,012	37,940	5,500a	8,249	1,407	83,000a	42,857	17,447	1,619	11,200	231,500
1941 ..	18,190	12,035	42,050	5,000a	5,000a	1,300	79,400a	51,000a	15,247	1,609	10,300	230,000
1942 ..	18,191	12,405	38,291	500a	4,400	1,030	15,748	9,938	7,833	1,363	11,400	119,000
1943 ..	17,480	12,666	41,523	1,000a	3,200	653	26,000	17,632	5,840	1,359	10,700	138,000
1944 ..	17,326	12,512	38,409	500a	3,300	337	9,300	6,738	3,296	1,289	7,700	101,000
1945 ..	17,077	11,230	42,483	---	3,500	86	3,152	948	1,775	1,162	8,600	90,000
1946 ..	14,091	10,338	37,819	350a	1,320	---	8,432	6,450	1,056	793	8,300	89,000
1947 ..	14,897	9,130	33,259	600a	4,000a	---	27,026	15,915	1,401	893	6,300	113,500
1948 ..	---	---	---	---	---	---	---	---	---	---	---	---
January ..	1,165	909	2,468	60a	400a	---	3,391	1,913	272	86	440	11,100
February ..	1,110	789	2,822	130a	400a	---	3,001	1,912	231	86	450	10,900
March ..	1,476	731	3,395	60a	400a	---	3,456	2,555	263	135	430	12,900
April ..	932	703	2,670	70a	400a	---	3,518	2,463	313	189	450	11,700
May ..	1,622	647	3,116	70a	400a	---	3,758	2,726	313	89	440	18,100
June ..	1,324	674	2,918	70a	400a	---	3,572	2,414	398	48	430	12,200
July ..	756	806	3,276	60a	400a	---	3,870	2,357	355	94	470	12,600
August ..	949	724	2,502	140a	400a	---	3,975	2,543	368	142	440	12,200
September ..	1,452	824	3,204	130a	400a	---	3,851	2,585	346	105	460	13,400
October ..	1,647	889	3,425	130a	400a	---	4,012	2,726	300a	83	460	13,500
November ..	---	---	---	---	---	---	4,153	---	---	---	---	---
December ..	---	---	---	---	---	---	4,268	---	---	---	---	---

a. Estimated. Source—Statistical Bulletin of the International Tin Study Group.

APPENDIX VI.

EXPORT DUTY ON TIN EXPRESSED AS A PERCENTAGE OF TOTAL REVENUE.

Year.	Total revenue.	Revenue duty on tin.	Percentage (b) to (a).	Labour employed in mining.	No. of mines operating.	Tin Restriction average Malayan quota release. (f)	Remarks.
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
1926	\$ 102,541,400	\$ 15,583,799	15.1	110,293	a	—	Yearly Average Tin Price \$144.93 per pikul " " " \$114.18 " " " " \$104.37 " Yearly Average Price of Tin decreased to \$72.89
1927	105,404,458	17,704,014	16.7	122,888	a	—	
1928	95,655,560	16,037,720	16.7	109,141	a	—	
1929	81,799,584	15,420,624	18.8	104,468	1,286	—	
1930	65,560,870	9,121,971	13.9	80,528	1,234	—	Tin Restriction introduced in 1931
1931	52,348,659	5,501,733	10.5	57,038	1,188	61.00	Tin Restriction ended on 31st December, 1946. Mining Industry being rehabilitated
1932	43,817,151	3,594,022	8.2	44,455	1,068	31.94	
1933	47,198,806	4,886,683	10.3	42,862	1,013	24.50	
1934	58,926,323	8,886,234	15.0	54,619	909	34.00	
1935	62,364,264	9,700,616	15.5	62,844	831	47.35	
1936	68,090,092	13,410,254	19.6	80,218	915	67.00	
1937	80,864,589	19,487,585	24.0	88,285	1,004	77.75	
1938	63,053,114	8,122,685	12.9	57,663	762	41.22	
1939	70,276,184	13,107,095	18.7	72,954	894	53.00	
1940	98,511,942	23,317,512	23.7	91,145	1,021	88.75	
1941	—	—	—	—	—	100	
1946	129,707,136	4,968,341	3.8	26,019	219	—	
1947	268,525,282	13,461,879	5.0	42,748	478	—	
1948	†273,440,000	29,429,689	10.8	51,270	614	—	

† Estimated. a. Figures not available.

APPENDIX V.

WORLD'S PRODUCTION, CONSUMPTION AND
STOCKS OF TIN.

	1940.	1941.	1947.	1948.
Belgian Congo	12,482 ...	16,190 ...	14,897 ...	14,073
Nigeria	12,012 ...	12,035 ...	9,139 ...	9,234
Bolivia	37,940 ...	42,050 ...	33,259 ...	37,309
Burma	5,359 ...	6,593 ...	1,818 ...	1,282*
China	6,249 ...	5,000* ...	4,000* ...	4,800*
French Indo-China	1,475 ...	1,295 ...	— ...	—
Malaya	83,000* ...	79,400* ...	27,026 ...	44,815
Netherlands East Indies	42,857 ...	51,000 ...	15,915 ...	30,562
Siam	17,447 ...	15,247 ...	1,401 ...	4,240
United Kingdom	1,619 ...	1,509 ...	898 ...	1,281
Other Countries	11,060 ...	8,681* ...	5,147* ...	5,304*
TOTAL ...	231,500 ...	239,000 ...	113,500 ...	152,900
Consumption ...	158,200 ...	169,400 ...	136,900 ...	138,900
World's overall stocks of metal and tin-in-ore ...	123,700 ...	180,600 ...	127,300† ...	132,500†

* Estimated.

† Excluding U.S.A. Strategic Stock pile.

(Figures taken from the Statistical Bulletin, April, 1949 of the International Tin Study Group).

APPENDIX VIII.

SUMMARY OF MINING STATISTICS FOR EACH MINERAL, 1948.

Mineral.	Production.	Value.	Duty.	Royalty.	Machinery (H.P.) employed.	Labour employed.
	Tons.	\$	\$			
Tin-in-ore	44,815	202,115,650	29,429,689	—	232,932	46,861
Gold Troy Ozs. .. .	10,212	708,713	—	—	1,231	617
Coal	375,460	7,696,930	—	—	9,947	2,172
Bauxite	—	—	—	—	—	5
Wolfram	46	90,451	2,121	—	—	—
Scheelite	29	24,058	—	—	—	50
Iron-ore	641	3,421	28,153*	—	2,370	1,544
Kaolin	923	73,840	24	—	—	21
Ilmenite (Exports) .. .	13,566	13,566	1,356	—	—	—

* Includes \$27,812 being export duty on 70,546 tons of Iron-ore exported from old stock.

APPENDIX VII.

PRODUCTION OF GOLD, IN FINE OZS. TROY, BY METHODS OF MINING, 1948.

States.	Dredging.		Gravel Pumping.		Hydraulicng.		Open Cast.		Underground.		Miscellaneous.		Total.		Dulang passes.	
	No. of mines.	Production.	No. of mines.	Production.	No. of mines.	Production.	No. of mines.	Production.	No. of mines.	Production.	No. of mines.	Production.	No. of mines.	Production.	No.	Production.
Perak ..	3	911.12	8	212.61	3	32.34	—	—	—	—	1	2.13	15	1,158.20	—	—
Selangor ..	5	205.77	—	—	—	—	—	—	—	—	—	—	5	205.77	—	—
N. Sembilan ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pahang ..	—	—	1	23.0	1	3.0	1	2.0	1	8,820.63	—	—	4	8,848.63	—	—
Johore ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Trengganu ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kedah ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Perlis ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kelantan ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Malacca ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total ..	8	1,116.89	9	235.61	4	35.34	1	2.0	1	8,820.63	1	2.13	24	10,212.60	—	—

A classification of the gold production for 1948 according to method of mining employed is given in Table 20.

APPENDIX X.

PROGRESS OF LOANS TO, AND REHABILITATION OF, CHINESE MINES.

Month.	*No. of Loans approved.	† Progress in Amounts of Loans approved.	Progress of Actual Allocations.			Aided Mines Producing.			Monthly Production, etc., from Aided Mines.		
	Progress total of approved applications.	Total amount in full.	Total value.	Cash advances.	Credits to T.A.A. (Nett).	No. all types.	No. G.P.	No. others.	Piculs tin-ore.	Value (estimated).	Export duty (estimated).
January	343	\$ 13,128,906	\$ 11,891,312	\$ 8,390,459	\$ 3,500,853	214	201	13	15,206	2,356,930	564,447
February	347	13,929,556	12,358,112	8,805,159	3,552,953	218	204	14	12,509	1,938,895	464,834
March	353	15,593,746	13,310,117	9,533,004	3,777,113	222	209	13	15,058	2,333,990	558,953
April	359	16,323,846	13,860,632	9,959,119	3,901,513	223	214	14	14,908	2,347,187	560,925
May	363	16,760,946	14,715,867	10,637,354	4,073,513	239	225	14	17,050	2,676,850	641,080
June	367	17,183,971	15,273,011	11,165,148	4,107,863	243	229	14	17,520	2,995,920	728,832
July	376	17,825,771	15,947,561	11,739,943	4,207,613	250	237	13	17,529	2,997,459	729,206
August	380	18,069,371	16,136,791	11,883,148	4,248,643	267	252	15	19,054	3,258,234	792,646
September	383	18,137,371	16,374,241	12,125,598	4,248,643	278	261	17	19,131	3,271,401	795,850
October	386	18,231,871	16,773,341	12,496,098	4,277,243	278	262	16	19,357	3,310,047	805,251
November	388	18,391,271	16,965,691	12,673,293	4,292,393	279	261	18	20,551	3,514,221	854,922
December	390	18,459,586	17,164,010	12,841,693	4,322,312	282	264	18	21,330	3,647,430	887,323
Total for 1948 ..									209,293	34,648,564	8,383,774
Total for 1947 ..									98,756	13,784,979	2,294,233
Total for 1946 ..									8,976	1,030,086	179,879
									317,025	49,463,629	10,857,936

* Including loans approved in full and loans approved conditionally.
 " approved fully ".

† Including supplementary loans approved and conversion of loans " approved conditionally " to loans

APPENDIX IX.

LOANS TO REHABILITATE EUROPEAN TIN MINES.

LOANS TO REHABILITATE EUROPEAN TIN MINES

1948.	Advances paid.	Progressive totals.	Production from " aided " European mines.			Production from all European mines.			(A) as percentage of (B).
			Piculs tin-ore (A).	Estimated.		Piculs Tin-ore (B).	Estimated.		
				Value to producers.	Export duty.		Value to producers.	Export duty.	
	\$	\$		\$	\$		\$	\$	
Total up to December, 1947 ..	—	29,537,237	—	—	—	—	—	—	95.9
January ..	5,326,299	34,863,536	43,295	6,710,725	1,607,110	45,124	6,994,220	1,675,003	96.8
February ..	1,540,285	36,403,821	40,495	6,276,725	1,503,174	41,793	6,477,915	1,551,356	96.6
March ..	35,000	36,438,821	45,488	7,050,640	1,688,515	47,064	7,294,920	1,747,016	97.8
April ..	186,179	36,625,000	46,757	7,317,471	1,748,712	47,806	7,481,639	1,787,944	97.4
May ..	6,792,773	43,417,773	48,955	7,685,935	1,840,708	50,217	7,884,069	1,888,159	96.9
June ..	2,173,241	45,591,014	43,681	7,469,451	1,817,130	45,057	7,704,747	1,874,371	96.9
July ..	3,011,433	48,602,447	49,250	8,421,750	2,048,800	50,810	8,638,510	2,113,696	96.3
August ..	281,775	48,884,222	49,468	8,459,028	2,057,869	51,339	8,778,969	2,135,702	96.3
September ..	149,571	49,033,793	46,429	7,939,359	1,931,446	48,171	8,237,241	2,003,914	96.2
October ..	200,044	49,233,837	49,560	8,474,760	2,061,696	51,512	8,808,552	2,142,899	96.4
November ..	101,500	49,335,337	50,061	8,560,431	2,082,538	51,925	8,879,175	2,160,080	96.2
December ..	—	49,335,337	50,697	8,669,187	2,108,995	52,370	8,955,270	2,178,592	96.7
Total ..	19,798,100	49,335,337	564,136	93,035,462	22,496,693	583,188	96,185,227	23,258,732	96.7

APPENDIX XI.

MACHINERY FOR MINES SCHEME.

1948.	Allocation of credits to "T.A.A."	Cash sales from machinery reserves.	Total credits to "T.A.A."	HORSE-POWER—DIESEL ENGINES.	
				Approved with loans.	Released to "Aided" mines.
	\$ c.	\$ c.	\$ c.		
January ..	138,300 00	121,315 25	259,615 25	748	884
February ..	52,100 00	* 9,041 25	61,141 25	1,470	758
March ..	224,160 50	13,176 00	237,336 50	334	1,292
April ..	124,400 00	19,180 50	143,580 50	1,674	1,418
May ..	177,000 00	4,403 15	181,403 15	140	870
June ..	29,350 00	8,582 50	37,932 50	264	802
July ..	99,750 00	43,745 70	143,495 70	1,028	1,602
August ..	41,030 00	5,976 75	47,006 75	202	603
September ..	—	24,391 70	24,391 70	—	336
October ..	28,600 00	14,748 70	43,348 70	—	476
November ..	15,150 00	12,606 50	27,756 50	404	—
December ..	29,919 00	† 17,127 25	47,046 25	—	202
Total ..	959,759 50	291,300 25	1,254,059 75	6,264	9,248
Total 1946/47	3,362,553 00	‡ 669,379 21	4,031,932 21	34,040	23,999
GRAND TOTAL	4,322,312 50	963,679 46	5,285,991 96	40,304	33,247

Note—

* Including deposit (\$2,001) paid in respect of Hire-Purchase on sale of equipment.

† Including deposit (\$2,576.25) paid in respect of Hire-Purchase on sale of equipment. Releases of diesel engines were only effected, when securities duly completed.

‡ This figure should read \$673,136.37 as 78 cts. Bank Commission not included.
Less refund to purchasers 3,807.16\$669,379.21

APPENDIX XII.
EMPLOYMENT STATISTICS BY RACES ON 31st DECEMBER, 1948.
Excluding Dulang Washing.

States and Races.	Employed in production of					Employed in types of mining.						
	Tin.	Coal.	Gold.	Other.	Total.	Dredging.	Gravel pumping.	Hydrau- licing.	Open- cast.	Under- ground.	Miscel- laneous.	Total.
Chinese :												
Perak	19,247	—	—	61	19,308	3,138	13,868	1,600	—	103	599	19,308
Selangor	8,823	1,095	—	10	9,928	2,511	5,540	46	1,179	643	9	9,928
Negri Sembilan	1,284	—	—	—	1,284	606	599	71	8	—	—	1,284
Pahang	1,794	—	377	—	2,171	—	375	—	—	1,719	77	2,171
Johore	532	—	—	5	537	149	348	35	5	—	—	587
Trengganu	465	—	—	133	598	—	325	—	116	87	—	598
Kedah	294	—	—	—	294	23	105	—	166	—	—	294
Perlis	912	—	—	—	912	—	34	12	8	—	—	912
Kelantan	—	—	—	—	—	—	—	—	—	—	—	—
Malacca	221	—	—	—	221	—	171	—	38	—	—	221
Total ..	33,572	1,095	377	209	35,253	6,427	21,425	1,764	1,520	3,410	707	35,253
Indians :												
Perak	3,736	—	—	14	3,750	1,840	1,363	526	—	—	21	3,750
Selangor	1,677	1,010	—	—	2,687	1,217	199	—	1,160	111	—	2,687
Negri Sembilan	77	—	—	—	77	64	13	—	—	—	—	77
Palung	62	—	57	—	119	—	1	—	—	118	—	119
Johore	16	—	—	—	16	15	1	—	—	—	—	16
Trengganu	16	—	—	141	157	—	16	—	141	—	—	157
Kedah	33	—	—	—	33	25	8	—	—	—	—	33
Perlis	—	—	—	—	—	—	—	—	—	—	—	—
Kelantan	—	—	—	—	—	—	—	—	—	—	—	—
Malacca	1	—	—	—	1	—	1	—	—	—	—	1
Total ..	5,618	1,010	57	155	6,840	3,161	1,602	526	1,301	229	21	6,840

APPENDIX XII—(cont.)
 EMPLOYMENT STATISTICS BY RACES ON 31st DECEMBER, 1948—(cont.)
Excluding Dulang Washing—(cont.)

States and Races.	Employed in production of					Employed in types of mining.						
	Tin.	Coal.	Gold.	Other.	Total.	Dredging.	Gravel pumping.	Hydrau-licing.	Open-cast.	Under-ground.	Miscel-laneous.	Total.
Malays :												
Perak	4,364	—	—	—	4,364	3,291	352	721	—	—	—	4,364
Selangor	1,402	45	—	—	1,447	1,313	22	—	107	5	—	1,447
Negri Sembilan	282	—	—	—	282	282	—	—	—	—	—	282
Pahang	439	—	116	—	555	—	2	—	—	—	—	555
Johore	75	—	—	—	75	75	—	—	—	—	—	75
Trengganu	182	—	—	1,246	1,428	—	79	—	1,243	95	21	1,438
Kedah	92	—	—	—	92	92	—	—	—	15	—	92
Perlis	15	—	—	—	15	—	—	—	—	—	—	15
Kelantan	—	—	—	—	—	—	—	—	—	—	—	—
Malacca	4	—	—	—	4	—	4	—	—	—	—	4
Total ..	6,885	45	116	1,246	8,292	5,053	459	721	1,350	688	21	8,292
Europeans :												
Perak	232	—	—	—	232	200	15	17	—	—	—	232
Selangor	134	22	—	—	156	125	3	—	14	14	—	156
Negri Sembilan	10	—	—	—	10	10	—	—	—	—	—	10
Pahang	35	—	13	—	48	—	—	—	—	48	—	48
Johore	3	—	—	—	3	3	—	—	—	—	—	3
Trengganu	—	—	—	10	10	—	—	—	10	—	—	10
Kedah	3	—	—	—	3	3	—	—	—	—	—	3
Perlis	—	—	—	—	—	—	—	—	—	—	—	—
Kelantan	—	—	—	—	—	—	—	—	—	—	—	—
Malacca	—	—	—	—	—	—	—	—	—	—	—	—
Total ..	417	22	13	10	462	341	18	17	24	62	—	462

APPENDIX XII—(cont.)
 EMPLOYMENT STATISTICS BY RACES ON 31st DECEMBER, 1948—(cont.)
 Excluding Dulang Washing—(cont.)

States and Races.	Employed in production of					Employed in types of mining.						
	Tin.	Coal.	Gold.	Other.	Total.	Dredging.	Gravel pumping.	Hydraulic.	Open-cast.	Underground.	Miscellaneous.	Total.
Others :												
Perak	278	—	—	—	278	194	74	10	—	—	—	278
Selangor	58	—	—	—	58	54	2	2	—	—	—	58
Negri Sembilan	8	—	—	—	8	3	—	—	—	—	—	8
Pahang	3	—	54	—	57	—	12	—	—	45	—	57
Johore	2	—	—	—	2	2	—	—	—	—	—	2
Trengganu	—	—	—	—	—	—	—	—	—	—	—	—
Kedah	—	—	—	—	—	—	—	—	—	—	—	—
Perlis	—	—	—	—	—	—	—	—	—	—	—	—
Kelantan	—	—	—	—	—	—	—	—	—	—	—	—
Malacca	25	—	—	—	25	—	19	—	—	—	6	25
Total ..	369	—	54	—	423	253	107	12	—	45	6	423
Total Labour Force :												
States.												
Perak	27,357	—	—	75	27,932	8,663	15,672	2,874	—	108	620	27,932
Selangor	12,094	2,172	—	10	14,276	5,220	5,766	44	2,460	773	9	14,276
Negri Sembilan	1,656	—	—	—	1,656	965	612	71	8	—	—	1,656
Pahang	2,353	—	617	—	2,970	—	300	—	5	2,503	77	2,970
Johore	628	—	—	5	633	244	340	35	—	—	—	633
Trengganu	673	—	—	1,530	2,203	—	480	—	1,510	182	31	2,203
Kedah	422	—	—	—	422	143	113	—	166	—	—	422
Perlis	927	—	—	—	927	—	34	12	8	873	—	927
Kelantan	—	—	—	—	—	—	—	—	—	—	—	—
Malacca	251	—	—	—	251	—	105	—	38	—	18	251
Total ..	46,861	2,172	617	1,620	51,270	15,235	23,611	3,040	4,105	4,434	755	51,270

APPENDIX XII—(cont.).

EMPLOYMENT OF LABOUR ON MINES BY RACES IN STATES DURING 1948.

Races.	Perak.	Selangor.	Negri Sembilan.	Pahang.	Johore.	Trengganu.	Kedah.	Perlis.	Kelantan.	Malacca.	Total.
Chinese	19,308	9,928	1,284	2,171	537	598	294	912	—	221	35,253
Indians	3,750	2,687	77	119	16	157	33	—	—	1	6,840
Malays	4,364	1,447	282	575	75	1,438	92	15	—	4	8,292
Europeans	232	156	10	48	3	10	3	—	—	—	462
Others	278	58	3	57	2	—	—	—	—	25	423
Total Labour Force ..	27,932	14,276	1,656	2,970	633	2,203	422	927	—	251	51,270

APPENDIX XIII.
DETAILS OF FATAL ACCIDENTS.

Date and time.	Name and situation of mine.	Name of owner.	Method of mining.	Name, sex, age and occupation of persons killed.	Cause of accident and remarks.
Perak :					
3-1-48 at 12.45 p.m. . .	Wan Hin Kongai, Batu Ampor	Lee Koon Voon . . .	Miscellaneous	Cheah Pek Nyuk (female), 15 years, Dulang Washer	Killed by a fall of sand. The deceased was washing for tin-ore in the effluent of the palong and probably undercutting the bank of old sands at an old mine when a fall of sand buried her. No blame attachable to mine management.
30-3-48 at 9.30 a.m.	Tai Lee Lawit Mine, Lawit, Sungai Siput	Tai Lee Limited . . .	Working Old Tailings	Yap Kong Yeow (female), age 39 years, Dulang Washer	Fall of ground. Deceased was undercutting the loose earth of the old disused tailings area when she was suddenly buried by the fall of earth above her. No blame attachable to the management.
7-4-48 evening . . .	Yean Foong Kongai, Siputeh	Lam Shin Kon . . .	Miscellaneous	Choong Keow (female), age 23 years, Dulang Washer	Drowning. The mine was worked out and mine-hole flooded. Deceased was working without permission and was apparently drowned while washing for tin-ore at the mine-hole. No blame attachable to mine management.
6-6-48 at 11.20 p.m. . .	Southern Kinta Consolidated (Kinta Section), Batu Gajah	Southern Kinta Consolidated (Kinta Section)	Dredging . .	Ahmad bin Ismail, Charge-man	Electrocution. Deceased was replacing a broken light bulb above the dredge screen and was electrocuted. Reported by Electricity Department.
17-8-48 at 2.45 p.m. . .	Jelapang Tin Dredging Ltd., Jelapang	Jelapang Tin Dredging Ltd.	"	Yap Yoon (male), age 28 years, Welder	Electrocution. Deceased was electrocuted while carrying out welding operations aboard the dredge. No blame attachable to the management.
13-9-48 at 2 a.m. . .	French Tekkah Mines, No. 3, Jelantoh Section	French Tekkah Mines . .	Hydraulicling	Yap Sin (male), age 51 years, Hydraulic elevator attendant	Bush of mud and water. Deceased was working in the sump of the mine when he was overwhelmed by a rush of slime from ahead of the mine face. No blame attachable to the management.
14-9-48 at 7 a.m. . .	Tai Lee No. 1 Mine, Sungai Buloh	Tai Lee Limited . . .	Gravel Pumping	Nor Bakhan (male Bengali), age 40 years old, unskilled. Employed to collect timbers at the bottom of the mine	Fall of ground. Deceased was standing in a ditch at the bottom of the mine when a big piece of earth (approximately 3 tons) broke away from the side of the ditch and fell on him. The manager of the mine was prosecuted for failing to take such due and proper precautions as to ensure the safety of persons working in the mine. He was found guilty and fined \$200 or two months R.I. The fine was paid.

APPENDIX XIII—(cont.)
DETAILS OF FATAL ACCIDENTS—(cont.)

Date and time.	Name and situation of mine.	Name of owner.	Method of mining.	Name, sex, age and occupation of persons killed.	Cause of accident and remarks.
Perak—(cont.)					
22-10-48 at 12.45 p.m.	Poh Onn Kongs, Kampar	Liew Chong Hee ..	Gravel Pumping	Arikam (male Indian), age about 40 years, Tindal	Fall of ground. Deceased was working in the tallayer at the bottom of the mine when he was buried by a fall of sand. No blame attachable to the management.
29-10-48 at 9 a.m.	Pengkalan Limited, Pengkalen	Pengkalan Ltd. ..	Dredging ..	Cheong Fatt (male), 55 years old, Dredge Coolie	Drowning. Fall from sampan into the dredge paddock. No blame to the management.
8-11-48 at 5 p.m.	Tai Lee Kongs, Lahat ..	Hew Yuk Chuan ..	Gravel Pumping	Wong Choy (male), age 54 years, Labourer	Lightning. Deceased was working on the palong in the chute house when a storm started and he was struck by lightning and killed instantaneously. No blame attachable to mine management.
9-11-48 at 1.10 a.m.	Yu Sang Loeng, Trench ..	Chong Kok Lim ..	"	Tet Onn (male), age 20 years, Shift labourer. Cheong Chan (male), age 24 years, Sump-man	Fall of ground. The deceased were both working at the time of the accident; Tet Onn blocking holes in the water pipes with wooden pegs and Cheong Chan in the sump. The North face of the mine, where the monitor was used for benching, slipped and buried both the deceased. It is considered that the accident could not have been foreseen and that no blame was attachable to the management of the mine.
26-11-48 at 3.40 a.m.	Tekkah Ltd., Kampong Kepayang	Tekkah Limited ..	Hydraulic	Khoo Nam (male), Monitor Man	Fall of ground. Deceased was operating a monitor at the foot of a small hill when a land-slide from the hill buried him. No blame to the management.
19-12-48	Weng Sang Kongs ..	Yip Seng	Gravel Pumping	Lee Kee Yoon (male), age 46 years, Unskilled labourer	Fatally injured when he slipped and the pipe he was carrying fell across his body.
Selangor :					
30-8-48	Malayan Collieries Ltd., Batu Arang	Malayan Collieries Limited	Open - cast Coal	Hussain Khan (male), 55 years, Labourer	Run over by vehicle. Deceased was employed in signalling to the drivers of earth-moving vehicles where to drop their loads on a dump. He was signalling to one when he was run over by another. No blame was attachable, and no enquiry under Sec. 79 (iii) of Cap. 147 was held.
15-9-48	" " " ..	" " " ..	Underground Coal	Lim Choon (male), 51 years, Coal hewer	Fall of coal from the roof of a level, near the face. Timbering was not as close up to the face as was desirable, but the roof was considered by experienced miners to be sound. An enquiry under Sec. 79 (iii) of Cap. 147 was held but no blame was attachable. Detailed timbering regulations for the mine have now been framed.

APPENDIX XIII—(cont.)

DETAILS OF FATAL ACCIDENTS—(cont.)

Date and time.	Name and situation of mine.	Name of owner.	Method of mining.	Name, sex, age and occupation of persons killed.	Cause of accident and remarks.
Selangor—(cont.) 3-12-48	Nam Khoo Kongsi, Setapak	Chang Tow Nam and Chong Khoo Lin	Gravel Pump	Wong Sang (male), 40 years, Labourer	Fall of a piece of rock in a gravel-pump mine. The limestone rock was generally somewhat fractured and falls were therefore not unlikely. An enquiry under Sec. 79 (III) was held but there was insufficient evidence to justify the institution of a prosecution for neglect of safety precautions.
Negri Sembilan : 4-4-48 at 1.15 p.m. ..	Mun Fong Tin Mining Co., Titi	Seow Mun	Gravel Pump	Kam Poh (male), age 55 years, Monitor labourer	Fall of earth.
Pahang : 7-1-48 at 9.57 a.m. ..	Raub Australian Gold Mine, Raub	Raub Australian Gold Mine, Raub	Lode (Gold) ..	Chan Onn (male), 33 years	Buried by fall of sand and timber. No blame attached to the management.
3-8-48 at 7.30 p.m. ..	Pahang Consolidated Co. Ltd., Sungai Lembing	Pahang Consolidated Co. Ltd., Sungai Lembing	Lode (Tin) ..	Hoo Kok Kheung (male), Underground loco driver	Fell from locomotive and run over by trucks. No blame attached to the management.
19-10-48 at 8.30 a.m. ..	" " "	" " "	" "	Chong Chiew (male), Timber Talkong	Crushed by fall of rock. No blame attached to the management.
Kedah : —	—	—	—	—	—
Perlis : 24-8-48 at 11.45 a.m. ..	Sun Woh Mine, Kaki Bukit, Perlis, M.C. 9	Loh Teng Cheng	Underground	Yong Tike (male), 50 years, Miner	Fell from a ladder. Verdict:—Death by misadventure. No blame attached to management, or any other person.
27-8-48 at 3.20 p.m. ..	Wang Batu Mine, Kaki Bukit, Perlis, M.C. 4/40	Estate of E.E. Graf ..	"	Lew Hon (male), 40 years, Miner	Fall of ground at working face. Verdict:—Death by misadventure. No blame attached to management, or any other person. Victim was thin stealing.
Johore : —	Sungei Besi Mines (Pelepah Dredge)	Sungei Besi Mines Limited	Dredging ..	Male, Name unknown ..	Fell on to the deck of the dredge from a height of about 17 feet. No blame attached to the management.

APPENDIX XIV.

FATAL ACCIDENTS ON MINES.

No. of Deaths from Fatal Accidents connected with Mining, other than Coal Mining, classified by Causes, 1948.

No. of Deaths from Fatal Accidents Connected with Mining, Quarrying, and other Industries.																										
	Open-cast and on Surface.								Underground.												States Total.	Average monthly labour force.	Fatality rate per 1,000 persons employed.			
	Falls of ground.	Haulage and Tramming.	Explosives.	Falls from a height.	Machinery. *	Electrical. *	Miscellaneous.	Total.	Falls.			Haulage and Tramming.	Hoisting.	Explosives.		Fire and Gases therefrom.	Suffocation by natural gases.	Falls from a height.	Machinery. *	Electrical. *				Miscellaneous.	Total.	
									Working face.	Shafts and winzes.	Roadways.			Explosives.	Gases from Explosives.											
Perak	6	1	—	—	—	3	3	13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13	26,318	0.494	
Selangor .. .	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	11,682	0.09	
Negri Sembilan ..	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1,719	0.58	
Pahang .. .	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	2	3	3	2,537	0.85	
Johore .. .	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	633	1.57	
Trengganu .. .	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2,203	—
Kedah .. .	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	422	—
Perlis .. .	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	2	2	700	2.86	
Kelantan .. .	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Malacca .. .	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	230	—
Totals .. .	8	1	—	1	—	3	3	16	1	—	—	1	—	—	—	—	—	1	—	—	2	5	21	46,444	0.45	

* Investigated by the Machinery or Electrical Department.

APPENDIX XV.

MACHINERY EMPLOYED IN MINING, 1936-1941 AND
1946, 1947, 1948.

Year.	Steam.	Oil.	Electric.	Gas.	Hydrau- lic.	Totals.
1936*	30,810	56,102	117,482	375	19,577	233,346
1937*	35,905	106,440	129,974	484	20,321	293,124
1938*	20,252	66,327	113,910	135	22,765	223,389
1939*	27,173	94,460	121,409	284	20,060	263,386
1940*	30,554	128,060	156,228	210	20,895	335,947
1941(Sept.)*	29,433	131,183	151,244	210	18,401	330,471
1946 (Jan.)†	25	1,332	9,075	—	—	10,432
1946 (Dec.)†	4,106	14,368	43,256	—	5,763	67,493
1947 (Dec.)†	14,982	62,248	82,675	—	10,180	170,094
1948— †						
January ..	14,793	60,670	83,328	—	15,570	180,361
February ..	15,850	68,914	85,983	—	15,439	186,195
March ..	18,169	72,780	88,999	—	15,564	195,512
April ..	19,205	78,665	89,869	—	15,917	203,746
May ..	18,715	80,675	92,304	—	15,984	207,678
June ..	19,389	84,468	94,910	—	15,799	214,566
July ..	19,359	90,597	96,827	—	15,875	222,658
August ..	17,969	95,124	97,864	—	15,324	226,281
September ..	17,969	97,423	97,616	—	15,831	228,839
October ..	17,969	101,097	99,299	—	16,050	234,415
November ..	18,330	104,910	99,940	—	15,863	239,043
December ..	18,126	106,072	104,865	—	15,683	244,746

* For the Federated Malay States. † For the Malayan Union.

APPENDIX XVI.

HORSE POWER OF TYPES OF MACHINERY ON 31st DECEMBER, 1948.

States and Horse Power.	Employed in production of					Employed in types of mine.						
	Tin.	Coal.	Gold.	Other.	Total.	Dredging.	Gravel pumping.	Hydraulic.	Open-cast.	Under-ground.	Miscellaneous.	Total.
Electric :												
Perak	67,209	—	—	—	67,209	39,410	32,955	3,844	—	—	—	67,209
Selangor	26,019	8,117	—	—	34,136	13,381	7,941	—	8,563	4,251	—	34,136
Negri Sembilan	—	—	—	—	—	—	—	—	—	—	—	—
Pahang	1,336	—	1,050	—	2,386	—	—	—	—	2,386	—	2,386
Johore	178	—	—	—	178	178	—	—	—	—	—	178
Trengganu	—	—	—	—	—	—	—	—	—	—	—	—
Kedah	—	—	—	—	—	—	—	—	—	—	—	—
Perlis	956	—	—	—	956	—	—	—	—	956	—	956
Kelantan	—	—	—	—	—	—	—	—	—	—	—	—
Malacca	—	—	—	—	—	—	—	—	—	—	—	—
Total ..	95,698	8,117	1,050	—	104,865	43,969	40,896	3,844	8,563	7,593	—	104,865
Oil :												
Perak	56,748	—	—	—	56,748	4,857	50,896	51	—	—	944	56,748
Selangor	26,532	1,795	—	—	28,327	1,496	24,964	—	1,839	—	28	28,327
Negri Sembilan	4,178	—	—	—	4,178	304	3,609	265	—	—	—	4,178
Pahang	8,245	—	181	—	8,426	—	1,786	—	—	6,598	42	8,426
Johore	1,699	—	—	—	1,699	88	1,611	—	—	—	—	1,699
Trengganu	1,134	—	—	2,370	3,504	—	1,104	—	2,370	30	—	3,504
Kedah	719	—	—	—	719	115	604	—	—	—	—	719
Perlis	1,341	—	—	—	1,341	—	226	—	—	1,115	—	1,341
Kelantan	—	—	—	—	—	—	—	—	—	—	—	—
Malacca	1,130	—	—	—	1,130	—	1,080	—	50	—	—	1,130
Total ..	101,726	1,795	181	2,370	106,072	6,860	85,880	316	4,259	7,743	1,014	106,072

APPENDIX XVI—(cont.)

HORSE POWER OF TYPES OF MACHINERY ON 31st DECEMBER, 1948—(cont.)

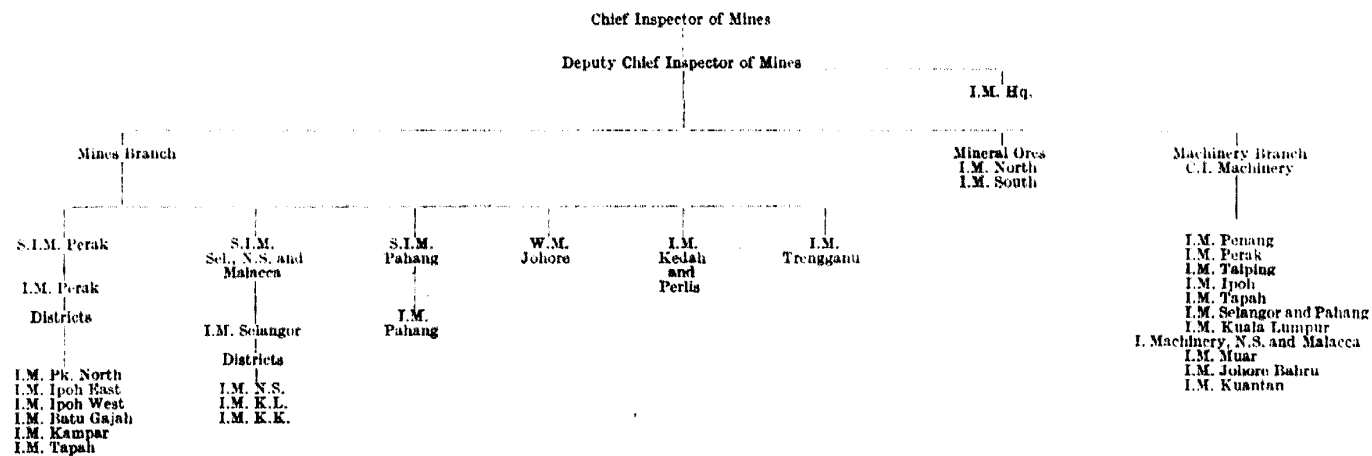
States and Horse Power.	Employed in production of					Employed in types of mine.						
	Tin.	Coal.	Gold.	Other.	Total.	Dredging.	Gravel pumping.	Hydraulic.	Open-cast.	Under-ground.	Miscellaneous.	Total.
Steam :												
Perak	5,495				5,495	5,495	—	—	—			5,495
Selangor .. .	9,588	35			9,623	9,623			35			9,623
Negri Sembilan ..	1,675				1,675	1,675						1,675
Pahang .. .	72				72					72		72
Johore .. .	881				881	881	45					881
Trengganu .. .												
Kedah .. .	380				380	380						380
Perlis .. .												
Kelantan .. .												
Malacca .. .												
Total ..	18,091	35			18,126	17,974	45		35	72		18,126
Hydraulic :												
Perak	15,353				15,353		276	15,077				15,353
Selangor .. .	220				220			220				220
Negri Sembilan ..												
Pahang .. .												
Johore .. .												
Trengganu .. .	10				10					10		10
Kedah .. .												
Perlis .. .	100				100			100				100
Kelantan .. .												
Malacca .. .												
Total ..	15,683				15,683		276	15,397		10		15,683

APPENDIX XVI—(cont.)

HORSE POWER OF TYPES OF MACHINERY ON 31st DECEMBER, 1948—(cont.)

States and Horse Power.	Employed in production of					Employed in types of mine.						
	Tin.	Coal.	Gold.	Other.	Total.	Dredging.	Gravel pumping.	Hydrau-licing.	Open-cast.	Under-ground.	Miscel-laneous.	Total.
Gas :												
Perak	—	—	—	—	—	—	—	—	—	—	—	—
Selangor .. .	—	—	—	—	—	—	—	—	—	—	—	—
Negri Sembilan ..	—	—	—	—	—	—	—	—	—	—	—	—
Pahang .. .	—	—	—	—	—	—	—	—	—	—	—	—
Johore .. .	—	—	—	—	—	—	—	—	—	—	—	—
Trengganu .. .	—	—	—	—	—	—	—	—	—	—	—	—
Kedah .. .	—	—	—	—	—	—	—	—	—	—	—	—
Perlis .. .	—	—	—	—	—	—	—	—	—	—	—	—
Kelantan .. .	—	—	—	—	—	—	—	—	—	—	—	—
Malacca .. .	—	—	—	—	—	—	—	—	—	—	—	—
Total ..	—	—	—	—	—	—	—	—	—	—	—	—
Total Horse Power :												
Perak .. .	144,805	—	—	—	144,805	40,762	84,127	18,972	—	—	944	144,805
Selangor .. .	62,359	9,947	—	—	72,306	24,465	32,905	220	10,437	4,251	28	72,306
Negri Sembilan ..	5,853	—	—	—	5,853	1,979	3,609	265	—	—	—	5,853
Pahang .. .	9,653	—	1,231	—	10,884	—	1,786	—	—	9,056	42	10,884
Johore .. .	2,758	—	—	—	2,758	1,102	1,656	—	—	—	—	2,758
Trengganu .. .	1,144	—	—	2,370	3,514	—	1,104	—	2,370	40	—	3,514
Kedah .. .	1,099	—	—	—	1,099	495	604	—	—	—	—	1,099
Perlis .. .	2,397	—	—	—	2,397	—	226	100	—	2,071	—	2,397
Kelantan .. .	—	—	—	—	—	—	—	—	—	—	—	—
Malacca .. .	1,130	—	—	—	1,130	—	1,080	—	50	—	—	1,130
Total ..	231,198	9,947	1,231	2,370	244,746	68,803	127,097	19,557	12,857	15,418	1,014	244,746

APPENDIX XVII.
SHOWING DISPOSITION OF SENIOR OFFICERS AND OFFICES.



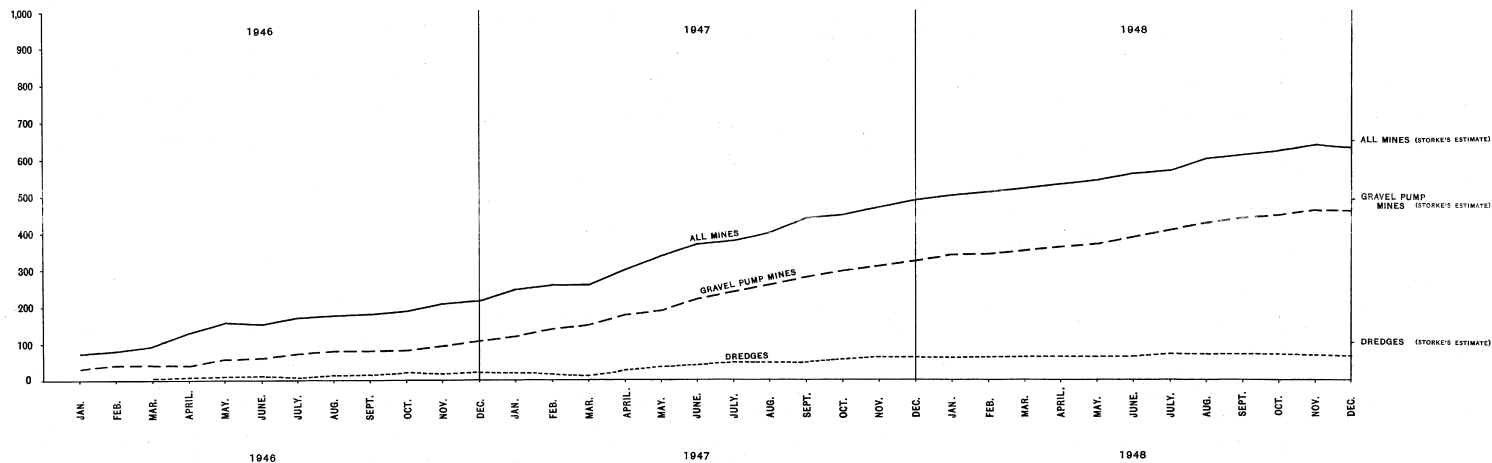
13182—725—15-7-49.

Government Press, Kuala Lumpur.

GRAPH I.

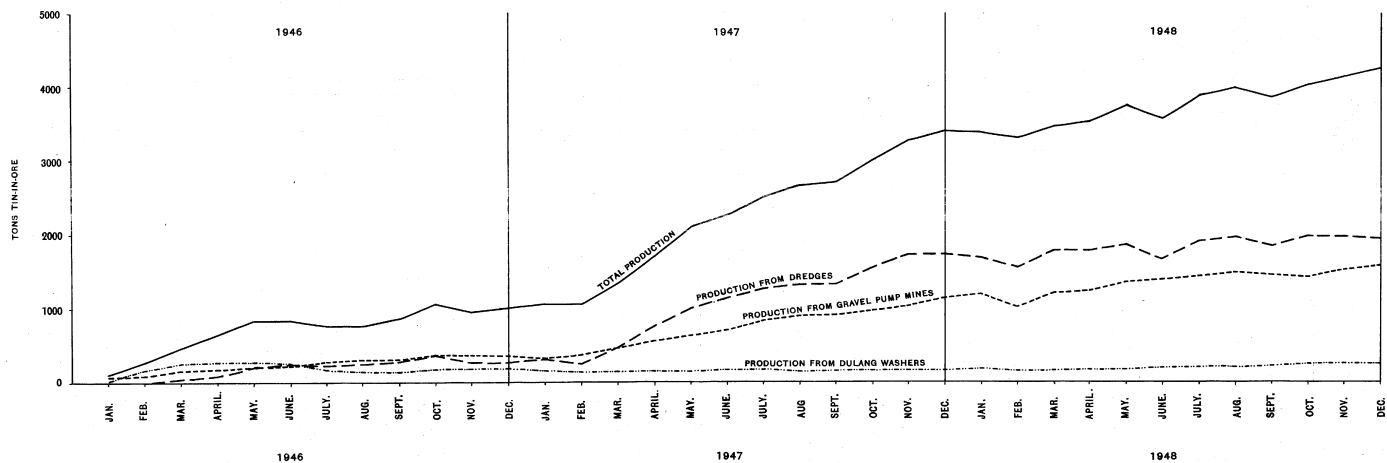
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PROGRESS IN NUMBER OF TIN MINES PRODUCING.



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GRAPH II
 Approved For Release 2001/09/06 : CIA-RDP83-00415R005000070003-5
 PRODUCTION FROM REHABILITATED TIN MINES.
 (TONS TIN-IN-ORE)



CPYRGHT

THIS IS AN ENCLOSURE
DO NOT DESTROY

Bulletin of Statistics
relating to the
MINING INDUSTRY
of
MALAYA

Compiled in
**THE OFFICE OF THE CHIEF INSPECTOR OF MINES,
MINES DEPARTMENT, FEDERATION OF MALAYA**

Published
BY AUTHORITY

NOTE.

Production, export and other figures given in this Bulletin, up to and including 1941, unless otherwise indicated, refer to the States of Perak, Selangor, Negri Sembilan and Pahang only. Subsequent figures refer to the whole of the Federation of Malaya.

2. Assay Values of Tin Concentrates.

1946	..	January-December	..	74.0%	metallic tin
1947	..	January-June	..	74.0%	„
		July	.. ..	75.0%	„
		August-December	..	75.5%	„
1948	..	January-December	..	75.0%	„

3. The total metallic tin content for the year, calculated from the above figures, is correct to within 0.14%.

4. Malayan Weights and Currency.

16 tahils = 1 katty.

1 katty = $1\frac{1}{3}$ lbs.

100 katties = 1 picul.

1 picul = $133\frac{1}{3}$ lbs.

16.8 piculs = 1 ton (long).

The Straits dollar is fixed at 2s. 4d.

J. SANDERSON,
*Ag. Chief Inspector of Mines,
Federation of Malaya.*

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BULLETIN OF STATISTICS RELATING TO THE MINING INDUSTRY OF MALAYA.

JANUARY-DECEMBER, 1948.

I.—PREFACE.

During the year Government continued the financial aid that was made available to the Industry during 1946 and 1947, and the results of that aid can be particularly seen on reference to Table 12, which shows the number of mines working each month. Had it not been for that financial aid it is very doubtful if so many gravel pump mines would have commenced operation.

Labour troubles on mines in the form of strikes took place during the first half of the year and caused a considerable loss of working hours which had its effect on production and also retarded rehabilitation. To follow those troubles, lawlessness broke out during June resulting in the Declaration by Government of an Emergency, and though the effect on production has not been noticeable in statistics yet it did effect production by causing stoppages on mines due to raids by the terrorists, etc. The emergency has definitely retarded rehabilitation and caused an almost complete cessation of prospecting work.

To counter the terrorist raids the mines obtained special constables who were armed and were stationed at the mines. In Perak the Chinese miners under the guidance of Government constructed block-houses at their mines to enable the special constables, if attacked, to offer a better defence.

The attacks on mines, and ambushes, have unfortunately resulted in some of the mining personnel losing their lives. Generally speaking little damage has been done on mines by the terrorists.

It is a very significant fact that since the emergency there has been practically no trouble with the labour on mines. It can therefore only be construed that the persons who were instigators of the strikes were also very closely associated with the terrorist movement.

Delays in delivery of plant and equipment ordered from overseas continued, especially in the case of electrical items.

The production of tin-in-ore in January, 1948, was 3,381 tons but in December, 1948, it was 4,268 tons. The rate of increase will be seen to have diminished as more mines have become fully rehabilitated. The figure of production for December is equivalent to an annual rate of 51,216 tons, or 64% of the 1940 production of 80,651 tons, which is the highest ever obtained.

The various associations representing the Mining Industry in Malaya are as follows :—

The F.M.S. Chamber of Mines;

The All Malaya Chinese Mining Association;

The Perak Chinese Mining Association;

The Miners' Association of Selangor, Negri Sembilan and Pahang;

The Malayan Mining Employers Association.

II.—TIN.

REGULATION OF PRODUCTION AND DISTRIBUTION.

In an attempt to control the fluctuations of stocks and prices, an International Control Scheme was introduced with effect from 1st March, 1931, and with variations the scheme persisted until the 31st December, 1946.

In connection with the scheme, an International Tin Research and Development Council was instituted, with Research Laboratories in England and a Statistical Office in Holland.

A Tin Study Group was set up in 1947 under the International Trade Organisation of U.N.O. to replace the International Tin Committee, and the activities of the Research Laboratories and the Statistical Office will continue substantially unchanged.

The American Government is now considering the accumulation of a stockpile of tin metal for strategic purposes, and this is likely to result in a long-term demand for the metal.

From 1st July, 1948, the export duty of \$30 per picul on tin-ore exported to all countries outside the British Commonwealth was rescinded.

Distribution of tin metal during 1948 was according to allocations made by the Combined Tin Committee in Washington and the Ministry of Supply, London, continued to be the only purchaser of tin from Malaya.

TABLE I.

STANDARD TONNAGES UNDER THE INTERNATIONAL TIN CONTROL SCHEME.

LONG TONS.

	1st Agreement March 1, 1931, to Dec. 31, 1931.	2nd Agreement January 1, 1934, to December 31, 1936.			3rd Agreement.	
	Standard tonnages.	Standard tonnages.			Jan. 1, 1937, to June 30, 1938.	July 1, 1938, to Dec. 31, 1941.
Bolivia	46,338	46,490			46,490	46,490
Malaya	69,366	71,940			71,940	77,335
Netherlands East Indies	35,730	36,330			36,330	39,055
Nigeria	10,734	10,890			10,890	10,890
	flat rate as from Sept. 1, 1931.	flat rates.				
		1934.	1935.	1936.		
Siam	10,000	9,800	9,800	9,800	18,000	18,000
Belgian Congo .. ..	..	4,500	6,000	7,000	13,200	13,200
Cornwall .. ..	..	1,700	1,700	1,700		
French Indo-China .. ..	..	1,700	2,500	3,000	3,000	3,000
Portugal .. ..	..	650	650	650		
Total standard tonnages	162,168	165,650			199,850	207,970
Standard tonnages — flat rates	172,168	184,000	186,300	187,800	199,850	207,970

From the Statistical Year Book, 1939, of the International Tin Research and Development Council.

JANUARY TO DECEMBER, 1948.

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TABLE 2.

PERMITTED PRODUCTION UNDER THE INTERNATIONAL
CONTROL SCHEME.

Year.	Annual average releases of percentage of standard tonnage.	Annual average of F.M.S. domestic quota.	Year.	Annual average releases of percentage of standard tonnage.	Annual average of F.M.S. domestic quota.
1931 ..	69.10 ..	61.00	1937 ..	107.50 ..	77.75
1932 ..	43.73 ..	31.94	1938 ..	55.64 ^c ..	41.22 ^c
1933 ..	33.33 ..	24.50	1939 ..	76.25 ..	53.00
1934 ..	49.00 ^a ..	34.00 ^a	1940 ..	115.00 ..	88.75
1935 ..	63.75 ^b ..	47.35 ^b	1941 ..	130.00 ..	100.00
1936 ..	92.50 ..	67.00	1942 to		
			1946 ..	105.00 ..	—

(a) Includes additional 4% to Malaya. (b) Includes Buffer Stock. (c) Includes special allowance of 7.56% to Malaya.

Note.—The above annual averages are correctly weighted for the varying periods of releases and quotas.

TABLE 3.

TOTAL PERMITTED AND ACTUAL EXPORTS UNDER THE
INTERNATIONAL CONTROL SCHEME.

IN LONG TONS OF TIN.

Country.	Period.	Permitted exports.	Actual exports.	ERROR.	
				Under- export (—) Over- export (+).	As per- centage of permitted exports.
Belgian Congo ..	1931-46*	177,457	142,156	— 35,301	19.89
Bolivia ..	1931-46†	599,429	476,527	— 122,902	20.50
French Indo-China ..	1931-41	22,367	11,518	— 10,849	48.50
Malaya ..	1931-41	596,783	573,418	— 23,365	3.92
Netherlands East Indies ..	1931-41	306,929	310,669	+ 3,740	1.22
Nigeria ..	1931-46*	160,961	143,810	— 17,151	10.65
Thailand ..	1931-41	150,537	135,815	— 14,722	9.78

* Up to and including June, 1946. † Up to and including September, 1946.

JANUARY TO DECEMBER, 1948.

TABLE 4.

CESS ON TIN-ORE EXPORT FOR RESTRICTION EXPENSES AND TIN RESEARCH AND DEVELOPMENT.

A.—RESTRICTION.

Year.	RECEIPTS.			PAYMENTS.	BALANCE.
	Cess.	Reimbursement by U.M.S.	Total.	Restriction expenses.	Surplus.
	\$ c.	\$ c.	\$ c.	\$ c.	\$ c.
1931 ..	37,868 07	111 16	40,029 73*	29,336 76	10,692 97
1932 ..	30,783 22	130 71	30,913 93	18,738 93	12,175 00
1933 ..	26,299 23	52 94	26,352 17	15,852 94	10,499 23
1934 ..	38,722 90	202 36	38,925 26	22,544 00	16,381 26
1935 ..	43,957 56	202 19	44,159 75	20,979 45	23,180 30
1936 ..	69,223 05	135 02	69,358 07	20,697 20	48,660 87
1937 ..	69,711 34	198 76	69,910 10	26,834 44	43,075 66
1938 ..	36,641 08	270 34	36,911 42	27,528 67	9,382 75
1939 ..	44,968 03	10,062 25	55,030 28	25,222 76	29,807 52
1940 ..	71,055 54	4,543 57	75,599 11	25,222 76	50,376 35
1946 ..	4,916 42	—	4,916 42	2,142 86	2,773 56
1947 ..	18,091 52	—	18,091 52	—	18,091 52
1948 ..	46,468 76	—	46,468 76	—	46,468 76
Total ..	538,706 72	15,909 30	556,666 52	235,100 77	321,565 75

* Includes \$2,050.50 appeal fees.

B.—RESEARCH AND DEVELOPMENT.

Year.	RECEIPTS.			PAYMENTS.		BALANCE.	CUMULATIVE BALANCE.
	Cess.	Contribution, Johore.	Surplus from restriction a/c A above.	Total.	Contribution to I.T.R.		
	\$ c.	\$	\$ c.	\$ c.	\$ c.	\$ c.	\$ c.
1932 ..	30,783 23	500	22,867 97	54,151 20	69,245 71	-15,094 51	-15,094 51
1933 ..	26,299 22	500	10,499 23	37,298 45	69,245 71	-31,947 26	-47,041 77
1934 ..	45,254 00	500	16,381 26	62,135 26	69,245 71	-7,110 45	-54,152 22
1935 ..	87,915 13	500	23,180 30	111,595 43	69,245 71	+42,349 72	-11,802 50
1936 ..	91,382 20	500	48,660 87	140,543 07	69,245 71	+71,297 36	+69,494 86
1937 ..	31,296 01	500	43,075 66	74,871 67	69,245 71	+ 5,625 96	+65,120 82
1938 ..	9,160 27	500	9,382 75	19,043 02	69,245 71	-50,202 69	+14,918 13
1939 ..	62,459 17	—	29,807 52	92,266 69	65,765 71	+26,500 98	+41,419 11
1940 ..	23,418 51	—	50,376 35	73,794 86	65,085 71	+ 8,709 15	+47,128 26
1946 ..	1,638 81	—	2,773 56	4,412 37	65,085 71	-63,673 34	-16,545 08
1947 ..	6,030 51	—	18,091 52	24,122 03	114,285 71	-90,163 68	-106,798 76
1948 ..	15,489 58	—	46,468 76	61,958 34	160,000 00	-98,041 66	-204,750 42
Total ..	431,126 64	3,500	321,565 75	756,192 39	960,042 81	-204,750 42	—

The Cess rates have been as follows:

5 cents as from 17th April, 1931 G.N. 2882
 10 cents as from 1st January, 1932 G.N. 8827
 15 cents as from 1st November, 1934 G.N. 5108
 10 cents as from 1st May, 1936 G.N. 1739
 5 cents as from 1st April, 1937 G.N. 1509
 10 cents as from 1st February, 1939 G.N. 294
 5 cents as from 1st February, 1940 G.N. 509
 4 cents as from 1st January, 1941 G.N. 1817

SOURCE: ACCOUNTANT-GENERAL, FEDERATION OF MALAYA.

JANUARY TO DECEMBER, 1948.

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TABLE 5.

EXPORTS OF TIN-IN-ORE, VALUE AND DUTY PAID.

TONS TIN-IN-ORE.

Year.	Exports.	Value. \$	Duty. \$	Per cent. of total Revenue.
1898	39,569	25,229,789	3,210,699	34.2
1899	38,353	41,612,038	6,181,542	45.8
1900	42,444	50,087,639	7,050,382	45.1
1901	46,742	48,468,440	6,968,183	39.7
1902	46,480	48,278,135	8,438,775	41.0
1903	49,962	54,156,787	9,590,505	42.3
1904	50,967	55,585,594	8,814,688	39.6
1905	50,991	60,533,398	9,249,627	38.5
1906	46,941	71,106,593	10,036,798	36.8
1907	48,431	69,375,290	9,395,825	32.6
1908	50,837	57,024,925	7,285,864	29.5
1909	48,743	54,858,815	7,155,124	28.3
1910	43,862	57,098,096	7,162,026	26.9
1911	44,148	69,698,687	8,818,764	25.1
1912	48,228	84,119,238	10,850,121	25.4
1913	50,126	83,629,668	10,729,888	24.2
1914	49,042	60,680,485	7,046,869	18.8
1915	46,761	61,403,930	7,235,086	17.7
1916	43,869	64,502,670	7,903,785	15.4
1917	39,832	72,755,983	9,331,288	14.2
1918	37,369	94,546,245	13,141,841	19.1
1919	36,935	74,871,634	9,944,177	13.7
1920	34,935	88,414,230	12,203,531	16.7
1921	34,491	49,266,770	6,153,360	11.3
1922	35,285	47,795,901	5,766,808	10.9
1923	37,649	64,347,862	8,265,195	12.9
1924	44,044	91,875,730	12,543,624	17.7
1925	45,926	101,655,377	14,000,633	16.1
1926	45,947	111,591,718	15,583,799	15.1
1927	52,180	127,027,368	17,704,014	16.7
1928	61,935	118,784,948	16,037,720	16.7
1929	67,043	117,538,390	15,420,646	18.8
1930	62,065	75,989,084	9,121,971	13.9
1931	53,455	51,135,004	5,501,733	10.5
1932	28,363	31,336,860	3,594,022	8.2
1933	23,924	37,665,444	4,886,683	10.3
1934	36,253	67,538,662	8,886,234	15.0
1935	40,785	76,160,164	9,700,616	15.5
1936	64,719	109,430,652	13,410,254	19.6
1937	75,394	151,418,742	19,487,585	24.0
1938	41,077	64,279,974	8,122,685	12.9
1939	52,232	100,226,619	13,107,095	18.6
1940	81,332	177,357,697	23,317,512	23.7
1941	* 61,645	140,355,512	22,818,987	—
1942		Not known		
1943		Not known		
1944		Not known		
1945	1,134†	2,915,514	407,646	—
1946†	10,340†	29,510,360	4,968,341	—
1947†	26,380	94,313,011	13,461,879	5.2
1948	44,792	203,680,836	29,425,879	—

* January-September only. † Please see Note. ‡ Purchases by the Tin-ore Buying Agency.

JANUARY TO DECEMBER, 1948.

1948.

EXPORTS OF TIN-IN-ORE, VALUE AND DUTY PAID.

	Exports. Tons.	Value.* \$	Duty. \$
January	3,147	13,382,353	1,935,675
February	3,347	14,232,836	2,053,419
March	3,143	13,365,343	1,924,875
April	3,733	15,937,810	2,306,953
May	3,657	15,681,333	2,223,188
June	3,643	17,183,798	2,473,539
July	3,812	18,010,419	2,611,921
August	4,105	19,409,918	2,832,013
September	3,928	18,554,520	2,686,482
October	4,036	19,050,437	2,774,810
November	4,105	19,363,022	2,773,398
December	4,136	19,509,247	2,829,606
Total	44,792	203,680,836	29,425,879

* The value is based on the estimated metallic tin content and the price of metallic tin
x Malayan Smelters.

TABLE 6.

STATE PRODUCTION AND VALUE OF TIN.

TONS TIN-IN-ORE.

Year.	PERAK.		SELANGOR.		NEGERI SEMBILAN.		PAHANG.		TOTAL.	
	Produc- tion.	Value. \$	Produc- tion.	Value. \$	Produc- tion.	Value. \$	Produc- tion.	Value. \$	Produc- tion.	Value. \$
1929 ..	44,638	74,799,166	20,356	34,018,183	1,965	3,290,371	3,040	5,097,632	69,999	117,205,352
1930 ..	41,697	43,945,372	18,904	22,244,069	1,827	1,931,593	2,855	3,943,079	64,983	78,464,113
1931 ..	34,086	32,465,493	14,974	14,309,277	1,610	1,533,860	2,445	2,335,920	53,115	50,644,550
1932 ..	17,262	19,040,986	8,363	9,255,853	907	1,004,865	1,305	1,435,800	27,827	30,737,504
1933 ..	16,083	23,688,693	7,133	11,162,303	658	1,011,129	1,069	1,689,843	23,893	37,561,968
1934 ..	22,273	42,784,801	10,982	21,000,615	1,081	2,079,032	1,878	3,607,815	36,214	69,562,263
1935 ..	25,047	46,785,792	12,689	23,719,949	1,279	2,396,063	1,776	3,822,553	40,791	70,224,357
1936 ..	39,038	66,005,375	21,115	35,737,315	1,789	2,991,568	2,760	4,646,918	64,682	109,381,176
1937 ..	44,875	89,059,361	24,575	49,047,005	2,510	4,960,327	3,158	6,200,073	75,118	149,266,766
1938 ..	24,958	39,075,974	12,633	19,836,917	1,891	2,623,091	1,923	2,944,397	41,205	64,480,379
1939 ..	26,466	50,454,715	15,159	28,909,992	1,209	2,477,345	1,713	3,266,890	44,627	85,108,942
1940 ..	48,906	106,673,218	25,736	56,036,050	2,705	5,908,693	3,244	7,071,621	80,651	175,787,582
1941 (Jan- Sept.)	36,589	83,315,515	19,094	43,462,527	1,954	4,448,226	2,655	6,043,017	60,292	137,269,287

During the Japanese occupation tin mining continued on a restricted scale.
The following figures are approximate only:

PRODUCTION.

(Tons.)

Year.	Tin-ore.	Tin-in-ore at 72%.
1942 ..	21,873	15,748
1943 ..	36,111	26,000
1944 ..	12,930	9,309
1945 ..	4,380	3,152

Note.—Prior to 1939 the production figures were based on deliveries to smelters and ore buyers; from
1939 onwards they represent actual production.

The valuation was based on the Customs tin price at the time of export inclusive of delivery and
refining charges.

JANUARY TO DECEMBER, 1948.

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TABLE 7.
STATE PRODUCTION OF TIN-IN-ORE.*
LONG TONS.

Year.	Perak.	Selangor.	Negri Sembilan.	Pahang.	Johore.	Trengganu.	Kedah.	Perlis.	Malacca.	Total.
1946	5,225	2,787	163	136	67	40	14	—	—	8,432
1947	17,868	6,779	826	592	243	226	261	179	53	27,026
1948—										
January ..	2,211	860	133	78	14	26	40	10	14	3,381
February ..	2,021	737	89	67	25	16	33	7	6	3,001
March ..	2,282	877	108	77	32	21	35	12	12	3,456
April ..	2,331	903	93	82	35	24	27	12	11	3,518
May ..	2,574	858	110	84	39	29	35	17	12	3,758
June ..	2,431	852	109	87	24	22	23	13	11	3,572
July ..	2,541	1,023	104	92	36	18	34	13	9	3,870
August ..	2,584	1,079	114	81	31	21	35	22	8	3,975
September ..	2,450	1,044	110	98	48	33	32	23	13	3,851
October ..	2,592	1,062	108	96	62	20	29	24	19	4,012
November ..	2,614	1,110	125	116	70	22	24	46	17	4,153
December ..	2,758	1,080	113	126	59	27	28	55	22	4,268
Total ..	29,389	11,494	1,316	1,079	475	279	375	254	154	44,815

TABLE 8.
METHOD OF PRODUCTION.
TONS TIN-IN-ORE.

Year.	Dredging.	Gravel pumping.	Hydraulic.	Open cast.	Under-ground.	Dulang washing.	Miscellaneous.	Total.
1929	27,211	29,031	5,864	2,745	3,244	1,057	847	69,999
1930	24,728	28,218	4,578	2,698	3,035	962	764	64,983
1931	22,068	20,394	3,372	2,927	2,383	1,414	557	53,115
1932	11,869	10,477	1,610	1,261	1,199	971	440	27,827
1933	10,759	8,713	1,359	1,101	957	735	269	23,893
1934	16,834	13,699	1,879	940	1,755	760	347	36,214
1935	18,302	16,691	2,036	934	1,522	871	435	40,791
1936	30,455	24,833	3,149	2,558	2,598	1,028	61	64,682
1937	36,157	28,712	3,248	3,020	2,910	1,005	66	75,118
1938	18,539	15,772	2,324	1,769	1,734	1,029	38	41,205
1939	21,407	16,270	2,547	1,712	1,803	853	35	44,627
1940	42,204	28,298	3,072	3,157	2,848	999	73	80,651
1941 (Jan.-Sept.) ..	30,670	21,695	2,256	2,409	2,268	943	51	60,292
1942	—	—	—	—	—	—	—	15,748
1943	—	—	—	—	—	—	—	26,000
1944	—	—	—	—	—	—	—	9,309
1945	—	—	—	—	—	—	—	3,152
1946*	2,067	2,707	560	8	140	2,142	808	8,432
1947*	12,826	8,827	1,546	324	690	1,768	1,045	27,026
1948—								
January ..	1,681	1,190	174	56	88	173	19	3,381
February ..	1,540	1,011	168	52	69	142	19	3,001
March ..	1,778	1,210	187	24	80	161	16	3,456
April ..	1,774	1,232	196	42	88	172	14	3,518
May ..	1,874	1,344	189	58	84	190	19	3,758
June ..	1,664	1,374	182	29	98	208	17	3,572
July ..	1,911	1,425	180	45	95	198	16	3,870
August ..	1,965	1,490	171	39	94	202	14	3,975
September ..	1,823	1,446	174	47	115	224	22	3,851
October ..	1,976	1,426	183	44	118	243	22	4,012
November ..	1,978	1,516	175	60	143	253	28	4,153
December ..	1,968	1,589	212	65	156	247	31	4,268
Total ..	21,932	16,253	2,191	561	1,228	2,413	237	44,815

* Please see Note.

JANUARY TO DECEMBER, 1948.

TABLE 9.

PRODUCTION BY EUROPEAN AND CHINESE MINES.

TONS TIN-IN-ORE.

Year.			European mines.	Per cent.	Chinese mines.	Per cent.	Other sources.	Per cent.	Total.
1929	..	..	43,472	62	25,470	36	1,057	2	69,999
1930	..	..	40,920	63	23,101	36	962	1	64,983
1931	..	..	35,003	65	16,698	32	1,414	3	53,115
1932	..	..	18,226	66	8,630	31	971	3	27,827
1933	..	..	15,846	66	7,312	31	735	3	23,893
1934	..	..	23,924	66	11,530	32	760	2	36,214
1935	..	..	26,731	66	13,189	32	871	2	40,791
1936	..	..	43,587	67	20,067	31	1,028	2	64,682
1937	..	..	50,757	68	23,356	31	1,005	1	75,118
1938	..	..	27,664	67	12,512	30	1,029	3	41,205
1939	..	..	30,991	69	12,783	29	853	2	44,627
1940	..	..	57,672	72*	21,956	27*	1,023	1	80,651
1941 (Jan.-Sept.)	..	..	42,586	71*	16,712	28*	994	1	60,292
1946†	..	..	3,228	38.3	3,061	36.3	2,143	25.4	8,432
1947†	..	..	16,167	59.8	9,091	33.7	1,768	6.5	27,026
1948†—									
January	..	..	2,014	59.6	1,194	35.3	173	5.1	3,381
February	..	..	1,866	62.2	993	33.1	142	4.7	3,001
March	..	..	2,101	60.8	1,194	34.5	161	4.7	3,456
April	..	..	2,134	60.6	1,212	34.5	172	4.9	3,518
May	..	..	2,242	59.6	1,326	35.3	190	5.1	3,758
June	..	..	2,011	56.3	1,353	37.9	208	5.8	3,572
July	..	..	2,268	58.6	1,404	36.3	198	5.1	3,870
August	..	..	2,292	57.7	1,481	37.2	202	5.1	3,975
September	..	..	2,150	55.8	1,477	38.4	224	5.8	3,851
October	..	..	2,300	57.3	1,469	36.6	243	6.1	4,012
November	..	..	2,318	55.8	1,582	38.1	253	6.1	4,153
December	..	..	2,338	54.8	1,683	39.4	247	5.8	4,268
Total	..	..	26,034	58.1	16,368	36.5	2,413	5.4	44,815

* About 11% of the European Production was obtained from Chinese Tributaries. † Please see Note.

TABLE 10A.

TOTAL MALAYAN PRODUCTION (PICULS OF TIN-ORE CONCENTRATES) FOR 1948.

Production by European and Chinese Mines and Method of Production.

State.	Mine.	Dredging.	Gravel Pumping.	Hydrau- licing.	Open Cast.	Under- ground.*	Dulang washing.†	Miscellaneous.‡	Totals.	Grand total.
Perak	European	321,338	23,462	38,437	—	—	—	1,221	384,458	658,299
	Chinese	—	221,810	10,142	—	1,575	37,022	3,292	273,841	
Selangor	European	139,292	3,157	—	6,903	—	—	—	149,352	257,498
	Chinese	—	89,808	202	2,841	—	15,137	73	108,146	
Negri Sembilan	European	16,690	—	—	—	—	—	—	16,690	29,429
	Chinese	—	11,365	101	14	—	979	280	12,739	
Pahang	European	—	—	—	—	18,509	—	188	18,697	24,178
	Chinese	—	5,198	—	—	—	228	115	5,481	
Johore	European	8,166	—	—	—	—	—	—	8,166	10,616
	Chinese	—	2,124	101	—	—	225	—	2,450	
Trengganu	European	—	—	—	—	—	—	—	—	6,288
	Chinese	—	4,217	—	15	1,974	—	82	6,288	
Kedah	European	5,825	—	—	—	—	—	—	5,825	8,400
	Chinese	—	816	—	1,298	—	461	—	2,575	
Perlis	European	—	—	—	—	—	—	—	—	5,694
	Chinese	—	91	107	83	5,413	—	—	5,694	
Malacca	European	—	—	—	—	—	—	—	—	3,467
	Chinese	—	2,012	—	1,403	—	—	52	3,467	
Totals	European	491,311	26,619	38,437	6,903	18,509	—	1,409	583,188	1,003,869
	Chinese	—	337,466	10,653	5,654	8,962	54,052	3,894	420,681	

* Includes Cave Workings.

† All ore washed is included here irrespective of the race of the washers.

‡ Also includes concentrates from re-treatment of amang produced by dredges, gravel pumps, etc.

JANUARY TO DECEMBER, 1948.

TABLE 10B.
 PRODUCTION BY EUROPEAN AND CHINESE MINES AND METHOD OF PRODUCTION.
 (Piculs of Tin-Ore Concentrates.)
 1948.
 STATE OF PERAK.

Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Under-ground.*	Dulang washing.†	Miscellaneous.‡	Totals.	Grand total.
January	European Chinese	25,008 —	1,952 16,352	3,016 812	— —	— 333	— 2,648	121 278	30,097 19,423	49,520
February	European Chinese	22,981 —	1,948 13,807	3,033 719	— —	— 128	— 2,252	74 325	28,036 17,231	45,267
March	European Chinese	26,253 —	2,028 15,679	3,317 860	— —	— 108	— 2,548	109 226	31,707 19,421	51,128
April	European Chinese	26,414 —	2,123 16,859	3,475 864	— —	— 50	— 2,661	117 164	32,129 20,048	52,217
May	European Chinese	30,250 —	2,241 17,671	3,372 826	— —	— 7	— 2,900	89 313	35,952 21,717	57,669
June	European Chinese	26,025 —	2,233 18,517	3,329 713	— —	— 152	— 3,148	97 236	31,684 22,766	54,450
July	European Chinese	27,560 —	2,241 19,796	3,170 838	— —	— 193	— 2,798	82 211	33,073 23,836	56,909
August	European Chinese	27,626 —	2,015 21,105	3,013 790	— —	— 142	— 2,923	75 194	32,729 25,154	57,883
September	European Chinese	25,485 —	1,666 20,091	2,929 924	— —	— 78	— 3,315	167 336	30,247 24,636	54,885
October	European Chinese	27,662 —	1,720 20,271	3,069 961	— —	— 215	— 3,727	109 309	32,580 25,473	58,053
November	European Chinese	27,372 —	1,587 20,944	3,104 764	— —	— 145	— 4,119	86 429	32,149 26,401	58,550
December	European Chinese	28,662 —	1,708 22,218	3,610 1,081	— —	— 30	— 3,993	95 371	34,075 27,693	61,768
Totals	European Chinese	321,338 —	23,462 221,810	38,437 10,142	— —	— 1,575	— 37,022	1,221 3,202	384,458 273,841	658,299

* Includes Cave Workings.

† All ore washed is included here irrespective of the race of the washers.

‡ Also includes concentrates from re-treatment of amalgam produced by dredges, gravel pumps, etc.

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TABLE 10C.
 PRODUCTION BY EUROPEAN AND CHINESE MINES AND METHOD OF PRODUCTION.
 (Piculs of Tin-Ore Concentrates.)
 1948.

STATE OF SELANGOR.

Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Under-ground.*	Dulang washing.†	Miscellaneous.‡	Totals.	Grand total.
January	European Chinese	10,203 —	260 6,798	— 27	845 137	— —	— 998	— —	11,303 7,960	19,268
February	European Chinese	9,414 —	184 5,205	— 11	775 142	— —	— 782	— 6	10,373 6,146	16,519
March	European Chinese	11,065 —	262 7,100	— 14	163 138	— —	— 897	— 2	11,490 8,151	19,641
April	European Chinese	11,193 —	313 6,982	— 13	519 163	— —	— 1,032	— 8	12,025 8,203	20,228
May	European Chinese	9,204 —	198 7,620	— 16	817 179	— —	— 1,187	— 7	10,219 9,009	19,228
June	European Chinese	9,117 —	298 7,749	— 18	300 201	— —	— 1,389	— 13	9,715 9,370	19,085
July	European Chinese	12,613 —	277 7,603	— 16	673 202	— —	— 1,522	— 9	13,563 9,357	22,920
August	European Chinese	13,723 —	361 7,829	— 6	507 242	— —	— 1,503	— 8	14,591 9,538	24,179
September	European Chinese	12,737 —	220 7,961	— 25	644 264	— —	— 1,535	— 6	13,601 9,791	23,392
October	European Chinese	13,481 —	169 7,809	— 23	500 255	— —	— 1,541	— 6	14,150 9,634	23,784
November	European Chinese	13,846 —	312 8,450	— 15	640 409	— —	— 1,386	— 3	14,798 10,263	25,061
December	European Chinese	12,696 —	303 8,782	— 13	520 509	— —	— 1,365	— 5	13,519 10,674	24,193
Totals	European Chinese	139,292 —	3,157 89,893	— 202	6,903 2,841	— —	— 15,137	— 73	149,352 108,146	257,498

* Includes Cave Workings.

† All ore washed is included here irrespective of the race of the washers.

‡ Also includes concentrates from re-treatment of amang produced by dredges, gravel pumps, etc.

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TABLE 10D.
 PRODUCTION BY EUROPEAN AND CHINESE MINES AND METHOD OF PRODUCTION.
 (Piculs of Tin-Ore Concentrates.)
 1948.
 STATE OF NEGRI SEMBILAN.

Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Under-ground.*	Dulang washing.†	Miscellaneous.‡	Totals.	Grand total.
January	European Chinese	1,746 —	— 1,100	— 15	— 1	— —	— 116	— —	1,746 1,232	2,978
February	European Chinese	1,204 —	— 702	— 7	— —	— —	— 66	— 5	1,204 780	1,984
March	European Chinese	1,326 —	— 996	— 9	— 1	— —	— 82	— —	1,326 1,088	2,414
April	European Chinese	1,030 —	— 948	— 7	— 1	— —	— 100	— —	1,030 1,056	2,086
May	European Chinese	1,192 —	— 1,150	— 17	— 2	— —	— 100	— —	1,192 1,269	2,461
June	European Chinese	1,283 —	— 1,037	— 16	— 1	— —	— 91	— —	1,283 1,145	2,428
July	European Chinese	1,333 —	— 932	— 1	— 2	— —	— 69	— —	1,333 1,004	2,337
August	European Chinese	1,516 —	— 949	— 3	— 2	— —	— 71	— —	1,516 1,025	2,541
September	European Chinese	1,356 —	— 980	— 3	— 1	— —	— 80	— 38	1,356 1,102	2,458
October	European Chinese	1,615 —	— 658	— 14	— 1	— —	— 74	— 48	1,615 795	2,410
November	European Chinese	1,563 —	— 1,110	— 6	— 1	— —	— 61	— 60	1,563 1,238	2,801
December	European Chinese	1,526 —	— 803	— 3	— 1	— —	— 69	— 129	1,526 1,005	2,531
Totals	European Chinese	16,690 —	— 11,365	— 101	— 14	— —	— 979	— 280	16,690 12,739	29,429

* Includes Cave Workings.

† All ore washed is included here irrespective of the race of the washers.

‡ Also includes concentrates from re-treatment of amalgam produced by dredges, gravel pumps, etc.

TABLE 10E.
 PRODUCTION BY EUROPEAN AND CHINESE MINES AND METHOD OF PRODUCTION.
 (Piculs of Tin-Ore Concentrates.)
 1948.
 STATE OF PAHANG.

Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Under-ground.*	Dulang washing.†	Miscellaneous.‡	Totals.	Grand total.
January	European Chinese	—	— 325	—	—	1,267	— 36	— 3	1,267 364	1,631
February	European Chinese	—	— 203	—	—	1,260	— 30	7 2	1,267 235	1,502
March	European Chinese	—	— 353	—	—	1,344	— 15	16 2	1,360 370	1,730
April	European Chinese	—	— 301	—	—	1,512	— 20	1 3	1,518 324	1,837
May	European Chinese	—	— 336	—	—	1,512	— 24	16 5	1,528 365	1,893
June	European Chinese	—	— 411	—	—	1,512	— 13	9 5	1,521 429	1,950
July	European Chinese	—	— 478	—	—	1,522	— 13	28 13	1,550 504	2,054
August	European Chinese	—	— 434	—	—	1,344	— 10	17 4	1,361 448	1,809
September	European Chinese	—	— 469	—	—	1,680	— 13	21 6	1,701 488	2,189
October	European Chinese	—	— 467	—	—	1,680	— 13	2 4	1,682 484	2,166
November	European Chinese	—	— 666	—	—	1,860	— 18	41 6	1,901 690	2,591
December	European Chinese	—	— 695	—	—	2,016	— 23	30 62	2,046 780	2,826
Totals	European Chinese	—	— 5,138	—	—	18,509	— 228	188 115	18,697 5,481	24,178

* Includes Cave Workings.

† All ore washed is included here irrespective of the race of the washers.

‡ Also includes concentrates from re-treatment of amang produced by dredges, gravel pumps, etc.

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TABLE 10r.
 PRODUCTION BY EUROPEAN AND CHINESE MINES AND METHOD OF PRODUCTION.
 (Piculs of Tin-Ore Concentrates.)
 1948.
 STATE OF JOHORE.

Month.	Mine.	Dredging.	Gravel Pumping.	Hydrau-licing.	Open Cast.	Under-ground.*	Dulang washing.†	Miscellaneous.‡	Totals.	Grand total.
January	European Chinese	120 —	151 —	— —	— —	— —	48 —	— —	120 194	314
February	European Chinese	463 —	82 —	— —	— —	— —	13 —	— —	463 95	558
March	European Chinese	579 —	110 —	— —	— —	— —	24 —	— —	579 134	713
April	European Chinese	679 —	86 —	— —	— —	— —	12 —	— —	679 98	777
May	European Chinese	778 —	92 —	— —	— —	— —	9 —	— —	778 101	879
June	European Chinese	438 —	90 —	— —	— —	— —	5 —	— —	438 95	533
July	European Chinese	658 —	125 —	— —	— —	— —	13 —	— —	658 138	796
August	European Chinese	509 —	171 —	5 —	— —	— —	12 —	— —	509 188	697
September	European Chinese	774 —	281 —	11 —	— —	— —	21 —	— —	774 293	1,067
October	European Chinese	1,069 —	257 —	27 —	— —	— —	35 —	— —	1,069 319	1,388
November	European Chinese	1,218 —	301 —	29 —	— —	— —	17 —	— —	1,218 347	1,565
December	European Chinese	886 —	398 —	29 —	— —	— —	21 —	— —	886 448	1,334
Totals	European Chinese	8,166 —	2,124 —	101 —	— —	— —	225 —	— —	8,166 2,450	10,616

* Includes Cave Workings.

† All ore washed is included here irrespective of the race of the washers.

‡ Also includes concentrates from re-treatment of amang produced by dredges, gravel pumps, etc.

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TABLE 10G.

PRODUCTION BY EUROPEAN AND CHINESE MINES AND METHOD OF PRODUCTION.

(Piculs of Tin-Ore Concentrates.)

1948.

STATE OF TRENGGANU.

Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulicng.	Open Cast.	Underground.*	Dulang washing.†	Miscellaneous.‡	Totals.	Grand total.
January	European Chinese	—	— 419	—	—	— 162	—	— 8	— 589	589
February	European Chinese	—	— 324	—	—	— 42	—	— 2	— 368	368
March	European Chinese	—	— 392	—	— 1	— 77	—	— 4	— 474	474
April	European Chinese	—	— 344	—	— 4	— 174	—	— 17	— 539	539
May	European Chinese	—	— 619	—	— 10	— 24	—	— 4	— 657	657
June	European Chinese	—	— 238	—	—	— 255	—	— 7	— 500	500
July	European Chinese	—	— 261	—	—	— 135	—	— 6	— 402	402
August	European Chinese	—	— 318	—	—	— 144	—	— 4	— 466	466
September	European Chinese	—	— 421	—	—	— 312	—	— 11	— 744	744
October	European Chinese	—	— 229	—	—	— 207	—	— 10	— 446	446
November	European Chinese	—	— 315	—	—	— 180	—	— 1	— 496	496
December	European Chinese	—	— 337	—	—	— 262	—	— 8	— 607	607
Totals	European Chinese	—	— 4,217	—	— 15	— 1,974	—	— 82	— 6,288	6,288

* Includes Cave Workings. † All ore washed is included here irrespective of the race of the washers.

‡ Also includes concentrates from re-treatment of amang produced by dredges, gravel pumps, etc.

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TABLE 10H.
 PRODUCTION BY EUROPEAN AND CHINESE MINES AND METHOD OF PRODUCTION.
 (Piculs of Tin-Ore Concentrates.)
 1948.

STATE OF KEDAH.

Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Under-ground. *	Dulang washing. †	Miscellaneous. ‡	Totals.	Grand total.
January	European Chinese	586 —	— 86	— —	— 203	— —	— 27	— —	586 316	902
February	European Chinese	450 —	— 39	— —	— 229	— —	— 32	— —	450 300	750
March	European Chinese	602 —	— 22	— —	— 118	— —	— 35	— —	602 175	777
April	European Chinese	430 —	— 45	— —	— 73	— —	— 46	— —	430 164	594
May	European Chinese	548 —	— 60	— —	— 112	— —	— 45	— —	548 217	765
June	European Chinese	421 —	— 23	— —	— 53	— —	— 24	— —	421 100	521
July	European Chinese	633 —	— 37	— —	— 67	— —	— 17	— —	633 121	754
August	European Chinese	633 —	— 77	— —	— 69	— —	— 15	— —	633 161	794
September	European Chinese	402 —	— 101	— —	— 73	— —	— 56	— —	402 230	722
October	European Chinese	416 —	— 138	— —	— 41	— —	— 50	— —	416 229	645
November	European Chinese	296 —	— 72	— —	— 121	— —	— 58	— —	296 251	547
December	European Chinese	318 —	— 116	— —	— 139	— —	— 66	— —	318 311	629
Totals	European Chinese	5,825 —	— 816	— —	— 1,298	— —	— 461	— —	5,825 2,575	8,400

* Includes Cave Workings.

† All ore washed is included here irrespective of the race of the washers.

‡ Also includes concentrates from re-treatment of amalgam produced by dredges, gravel pumps, etc.

TABLE 101.
 PRODUCTION BY EUROPEAN AND CHINESE MINES AND METHOD OF PRODUCTION.
 (Piculs of Tin-Ore Concentrates.)
 1948.
 STATE OF PERLIS.

Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulicig.	Open Cast.	Underground.*	Dulang washing.†	Miscellaneous.‡	Totals.	Grand total.
January	European Chinese	—	—	— 18	—	— 203	—	—	— 221	221
February	European Chinese	—	— 39	—	—	— 111	—	—	— 150	150
March	European Chinese	—	—	—	—	— 269	—	—	— 269	269
April	European Chinese	—	—	— 16	— 14	— 236	—	—	— 266	266
May	European Chinese	—	—	— 8	— 22	— 341	—	—	— 371	371
June	European Chinese	—	—	— 7	— 9	— 274	—	—	— 290	290
July	European Chinese	—	— 15	— 11	— 8	— 267	—	—	— 301	301
August	European Chinese	—	— 6	— 13	— 3	— 482	—	—	— 504	504
September	European Chinese	—	—	— 4	— 4	— 508	—	—	— 516	516
October	European Chinese	—	—	— 12	— 5	— 530	—	—	— 547	547
November	European Chinese	—	— 5	— 9	— 10	— 1,008	—	—	— 1,032	1,032
December	European Chinese	—	— 26	— 9	— 8	— 1,184	—	—	— 1,227	1,227
Totals	European Chinese	—	— 91	— 107	— 83	— 5,413	—	—	— 5,694	5,694

* Includes Cave Workings.

† All ore washed is included here irrespective of the race of the washers.

‡ Also includes concentrates from re-treatment of amang produced by dredges, gravel pumps, etc.

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TABLE 10J.
 PRODUCTION BY EUROPEAN AND CHINESE MINES AND METHOD OF PRODUCTION.
 (Piculs of Tin-Ore Concentrates.)
 1948.

SETTLEMENT OF MALACCA.

Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Underground.*	Dulang washing.†	Miscellaneous.‡	Totals.	Grand total.
January	European Chinese	—	223	—	80	—	—	9	312	312
February	European Chinese	—	122	—	13	—	—	6	141	141
March	European Chinese	—	156	—	111	—	—	6	272	272
April	European Chinese	—	97	—	153	—	—	6	256	256
May	European Chinese	—	111	—	150	—	—	1	271	271
June	European Chinese	—	179	—	73	—	—	4	256	256
July	European Chinese	—	166	—	54	—	—	3	219	219
August	European Chinese	—	117	—	53	—	—	3	173	173
September	European Chinese	—	211	—	73	—	—	3	287	287
October	European Chinese	—	226	—	190	—	—	3	419	419
November	European Chinese	—	207	—	163	—	—	6	376	376
December	European Chinese	—	208	—	281	—	—	2	491	491
Totals	European Chinese	—	2,012	—	1,403	—	—	52	3,467	3,467

* Includes Cave Workings.

† All ore washed is included here irrespective of the race of the washers.

‡ Also includes concentrates from re-treatment of amalgam produced by dredges, gravel pumps, etc.

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TABLE 11.

DULANG WASHING IN 1948.

STATE.	PASSES ISSUED IN 1948 TO					PRODUCTION.	
	Race: Chinese.	Malays.	Indians.	Others.	Total.	Piculs. Ore.	Tons. Tin-in-ore.
Perak	13,526	306	78	—	13,910	37,022	1,653
Selangor	5,055	170	—	—	5,225	15,137	676
Negri Sembilan	470	50	—	—	520	979	44
Pahang	272	7	—	—	279	228	10
Johore	147	—	—	—	147	225	10
Kedah	192	8	—	—	200	461	20
Other States	—	—	—	—	—	—	—
Total	19,662	541	78	—	20,281	54,052	2,413

TABLE 12.

NUMBER OF TIN MINES OPERATING.

Year.	Dredging properties.	Gravel pumping (mines).	Hydrau- licng.	Open cast.	Miscel- laneous.	Small workings without machinery.	Total.
1929	69	428	36	18	28	707	1,286
1930	68	316	35	22	17	776	1,234
1931	51	280	30	23	20	784	1,188
1932	28	231	38	35	14	722	1,068
1933	42	268	36	30	14	623	1,013
1934	53	367	36	13	31	409	909
1935	56	394	30	7	34	310	831
1936	68	527	26	8	35	251	915
1937	68	635	34	10	28	229	1,004
1938	50	372	32	17	11	280	762
1939	73	538	33	20	10	220	894
1940	72	733	34	22	9	151	1,021
1941 (Sept.)	74	668	31	17	10	133	933
1946 (Dec.)	21*	102	23	1	6	66	219
1947 (Dec.)	46	323	24	10	27	48	478
1948 —							
January	43	339	23	10	22	43	480
February	44	344	23	9	23	46	489
March	44	356	22	9	25	45	501
April	44	363	23	10	22	47	509
May	45	372	22	10	25	47	521
June	43	393	21	10	29	46	542
July	47	412	22	6	30	41	558
August	47	430	23	6	33	39	578
September	48	436	23	7	32	42	588
October	48	447	22	7	32	42	598
November	48	462	20	7	35	41	613
December	48	464	22	8	33	39	614

* These figures include properties whose dredges had stopped temporarily for conversion from coal to other fuels.

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TABLE 13.
DREDGES OPERATING AND STOPPED.

Year.	Operating.	Stopped.	Total.
1913	1 ..	— ..	1
1914	3 ..	— ..	3
1915	11 ..	— ..	11
1916	14 ..	— ..	14
1917	15 ..	— ..	15
1918	16 ..	— ..	16
1919	18 ..	— ..	18
1920	20 ..	— ..	20
1921	30 ..	— ..	30
1922	22 ..	11 ..	33
1923	33 ..	7 ..	40
1924	38 ..	4 ..	42
1925	40 ..	2 ..	42
1926	41 ..	11 ..	52
1927	48 ..	22 ..	70
1928	89 ..	— ..	89
1929	105 ..	— ..	105
1930	69 ..	38 ..	107
1931	56 ..	63 ..	119
1932	28 ..	91 ..	119
1933	23 ..	96 ..	119
1934	56 ..	62 ..	118
1935	70 ..	49 ..	119
1936	90 ..	26 ..	116
1937	93 ..	20 ..	113
1938	55 ..	60 ..	115
1939	96 ..	26 ..	122
1940	104 ..	19 ..	123
1941 (Sept.)	103 ..	18 ..	121*
1942 to 1945	No figures are available.		

TABLE 14.
DREDGES OPERATING AND REHABILITATING.

	Operating.	Rehabilitating.	Total.
1946 (Dec.)	18 ..	26 ..	44
1947 (Dec.)	56 ..	13 ..	69
1948—			
January	57 ..	11 ..	68
February	59 ..	17 ..	76
March	61 ..	15 ..	76
April	62 ..	14 ..	76
May	63 ..	13 ..	76
June	61 ..	11 ..	72
July	65 ..	12 ..	77
August	65 ..	12 ..	77
September	67 ..	9 ..	76
October	67 ..	10 ..	77
November	67 ..	10 ..	77
December	67 ..	10 ..	77

* The decrease in the number of dredges was due to two being dismantled.

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SMELTERS.

For many years practically all tin-ore concentrates produced in Malaya have been despatched either to the Straits Trading Company at Singapore or Butterworth or the Eastern Smelting Company at Penang where they have been smelted and refined.

The smelter of Tan Ban Joo Ltd. Pudu, Kuala Lumpur restarted work during January 1948 and a total of 310 piculs tin-ore was smelted.

TABLE 15.
PRICE OF TIN.

SINGAPORE --\$ PER PICUL.										London £ per long Ton. Stan- dard cash average.
Year.	Highest.		Lowest.		Average.		Fluctuations.			
	\$	c.	\$	c.	\$	c.	\$	c.	£	
1915	86	50	69	50	78	17	17	00	164.2	
1916	97	50	77	25	87	53	20	25	182.2	
1917	140	00	85	00	108	74	55	00	237.7	
1918	182	50	117	50	150	62	65	00	329.6	
1919	166	00	100	00	120	68	66	00	257.5	
1920	212	00	90	00	150	67	122	00	296.1	
1921	115	00	72	00	85	04	42	00	165.4	
1922	93	62	71	75	80	64	21	87	159.5	
1923	121	00	88	50	101	75	32	50	202.3	
1924	148	00	100	75	124	19	47	25	248.9	
1925	145	50	116	00	131	77½	29	50	261.1	
1926	157	50	131	75	144	59	25	75	291.2	
1927	159	00	127	37	144	93	31	63	289.1	
1928	131	50	103	62½	114	18	27	87½	227.2	
1929	115	50	89	25	104	37½	26	25	203.9	
1930	92	25	54	12½	72	89	38	12½	142.0	
1931	71	37½	50	37½	60	29	21	00	118.5	
1932	81	75	52	87½	69	76	28	87½	135.9	
1933	124	00	71	75	99	99	52	25	194.6	
1934	121	00	110	62½	114	41	10	37½	230.4	
1935	116	25	105	50	111	32	10	75	225.7	
1936	121	25	85	62½	100	39	35	62½	204.6	
1937	149	00	85	00	119	75	64	00	242.3	
1938	111	75	76	00	95	43	35	75	189.6	
1939	136	00	106	25	114	44	29	75	226.3	
1940	146	75	118	00	129	92	28	75	256.6	
1941— (Jan.-Sept.)	140	00	131	25	135	51	8	75	261.6	
1942	—	—	—	—	—	—	—	—	275.0	
1943	—	—	—	—	—	—	—	—	275.0	
1944	—	—	—	—	—	—	—	—	300.0	
1945	—	—	—	—	—	—	—	—	300.0	
1946— (Jan.-Oct.) ..	—	—	—	—	—	—	—	—	300.0	
(Nov.-Dec.) ..	Ex-Penang-Singapore smelters £370 (for export)								380.5	
1947	—	—	—	—	—	—	—	—	443.7	

During 1948 the Ministry of Supply in England continued to be the sole purchaser of exported metallic tin, for which it also fixed the following prices:

London £ per long ton.			Prices ex Malayan Smelters.		
Standard Cash.			£		
January ..	..	521	January-April 6th ..	..	500
February-May	522.5	April 7th-May 31st	504
June-December	572.5	June 1st-Dec. 31st	554

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III. OTHER MINERALS.

COAL.

The only deposit now mined in Malaya is situated at Batu Arang, Selangor. Approximately 11,625,000 tons had been produced up to the end of 1948.

Production during 1948 was 375,460 tons, which represents an increase of 66% over the amount won in 1947, and was 48% of the record tonnage in 1940.

Coal production was adequate to meet all requirements during 1948.

Coal was mined at Enggor, Perak, and the Enggor Coalfields Ltd. between 1925 and 1928 produced 28,500 tons. The deposit then proved uneconomical to work.

The following is a typical analysis of the Batu Arang Coal:

Per cent.			
Moisture	21	As received	9,000 B.T.U.
Volatile matter ..	35	Dry basis "	11,390 ..
Fixed carbon	35	Dry free-ash basis ..	12,850 ..
Ash	9		

In July an attack was made on the Malayan Collieries by insurgents but fortunately damage to machinery was not extensive and replacement parts were quickly obtained and no appreciable effect was caused to production of coal.

The mines both open-cast and underground, are now largely mechanized and belt conveyors are much used. Coal cutters are in regular use and "Joy" and "Duckbill" loaders are being tried underground. Most of the production is now from the underground mines.

During the whole of the year the price was unchanged at \$20.50 per ton f.o.r. Batu Arang.

TABLE 16.

COAL OUTPUT.

Year.	Production. Tons.	Value. \$	Year.	Production. Tons.	Value. \$
1915 ..	10,725 ..	53,046	1932 ..	282,860 ..	1,588,398
1916 ..	100,921 ..	482,374	1933 ..	218,246 ..	1,208,250
1917 ..	142,084 ..	762,445	1934 ..	321,860 ..	1,548,127
1918 ..	181,493 ..	1,257,473	1935 ..	392,153 ..	1,914,022
1919 ..	186,170 ..	1,500,434	1936 ..	520,750 ..	2,594,179
1920 ..	260,222 ..	2,247,080	1937 ..	628,948 ..	3,320,909
1921 ..	310,445 ..	2,767,072	1938 ..	477,908 ..	3,226,947
1922 ..	282,727 ..	2,230,122	1939 ..	441,025 ..	2,431,073
1923 ..	320,000 ..	2,376,779	1940 ..	781,509 ..	5,841,778
1924 ..	372,796 ..	2,696,645	1941* ..	687,000 ..	5,527,000
1925 ..	407,734 ..	2,958,764	1942 ..	244,590 ..	(Not known)
1926 ..	456,522 ..	3,327,792	1943 ..	480,442 ..	
1927 ..	449,581 ..	3,107,216	1944 ..	409,100 ..	
1928 ..	556,590 ..	3,496,737	1945 ..	226,702 ..	3,707,121
1929 ..	661,514 ..	3,902,662	1946 ..	224,674 ..	
1930 ..	567,166 ..	3,272,121	1947 ..	226,301 ..	
1931 ..	401,172 ..	2,317,064			4,176,368

*January-December.

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COAL, 1948.

Month.	Production. Tons.	Value. \$
January	31,364 ..	642,962
February	24,742 ..	507,211
March	31,914 ..	654,237
April	26,956 ..	552,598
May	30,431 ..	623,836
June	34,753 ..	712,437
July	31,379 ..	643,269
August	33,521 ..	687,180
September	31,534 ..	646,447
October	34,904 ..	715,532
November	31,098 ..	637,509
December	32,864 ..	673,712
Total	375,460 ..	7,696,930

COAL PRICE, 1948.

\$ c.
January-December, 1948 20 50 per ton.

GOLD.

The principal gold deposit situated at Raub, Pahang has been mined since 1889 by the Raub Australian Gold Mines Ltd. and the total production to 31st December, 1948, amounted to 767,030 oz. Troy.

This mine was damaged very severely during the war, and, though much rehabilitation work has been done, it is not likely to reach full production for some time.

There are a number of small gold workings in Pahang but the production is insignificant.

In the Bidor area of Perak gold is recovered with tin-ore from alluvial deposits and a small quantity is also recovered by tin dredges operating in Selangor.

TABLE 17.

Year.	Raw Gold production. Ozs.	Value. \$	Year.	Raw Gold production. Ozs.	Value. \$
1898 ..	22,200 ..	830,660	1924 ..	14,960 ..	509,624
1899 ..	18,507 ..	740,280	1925 ..	14,185 ..	483,219
1900 ..	17,048 ..	681,920	1926 ..	14,475 ..	493,101
1901 ..	23,948 ..	786,503	1927 ..	11,758 ..	391,306
1902 ..	19,753 ..	742,131	1928 ..	18,693 ..	680,364
1903 ..	14,811 ..	663,366	1929 ..	26,782 ..	974,777
1904 ..	20,157 ..	690,857	1930 ..	29,597 ..	1,077,232
1905 ..	9,972 ..	341,840	1931 ..	29,462 ..	1,209,330
1906 ..	11,580 ..	397,028	1932 ..	29,296 ..	1,162,238
1907 ..	15,353 ..	526,388	1933 ..	29,036 ..	1,452,598
1908 ..	14,887 ..	510,398	1934 ..	30,221 ..	1,783,280
1909 ..	16,244 ..	556,923	1935 ..	29,771 ..	1,812,606
1910 ..	16,767 ..	574,868	1936 ..	37,779 ..	2,115,273
1911 ..	9,228 ..	306,514	1937 ..	33,828 ..	1,894,047
1912 ..	14,421 ..	478,983	1938 ..	40,209 ..	2,261,752
1913 ..	14,975 ..	497,391	1939 ..	40,283 ..	2,457,045
1914 ..	14,272 ..	474,034	1940 ..	35,689 ..	2,191,805
1915 ..	18,641 ..	619,149	1941 (Jan.-		
1916 ..	17,386 ..	577,483	Sept.)	24,804 ..	1,494,230
1917 ..	18,154 ..	602,965	1942 ..	1,024 ..	
1918 ..	18,309 ..	608,124	1943 ..	2,213 ..	
1919 ..	16,402 ..	626,600	1944 ..	1,212 ..	(Not known)
1920 ..	12,823 ..	422,522	1945 ..	287 ..	
1921 ..	14,674 ..	506,546	1946 ..	445 ..	29,370
1922 ..	15,005 ..	578,763	1947 ..	5,312 ..	350,583
1923 ..	9,193 ..	313,233			

JANUARY TO DECEMBER, 1948.

TABLE 17A.

PRODUCTION OF RAW GOLD, 1948.

(The value of Raw Gold for the purpose of assessing royalty is based on \$66 per oz. *Gazette* Notification, F.M.S. No. 4414 of 8-9-1939.)

Month.	Pahang.		Perak.		Selangor.		Total.	
	Troy Ozs.	\$	Troy Ozs.	\$	Troy Ozs.	\$	Troy Ozs.	\$
January	403	20,028	127	8,382	11	726	546	36,036
February	625	41,250	145	9,570	14	924	784	51,744
March	625	41,250	124	8,184	11	726	760	50,160
April	596	39,336	88	5,808	14	924	698	46,068
May	640	42,240	95	6,270	18	858	748	49,368
June	1,915	66,990	66	4,356	16	1,056	1,997	72,402
July	1,067	70,422	69	4,554	18	1,188	1,154	76,164
August	474	31,284	77	5,082	20	1,320	571	37,686
September	750	49,500	95	6,270	22	1,452	867	57,222
October	694	45,804	85	5,610	20	1,320	799	52,734
November	684	45,144	82	5,412	20	1,320	786	51,876
December	1,271	83,886	105	6,930	26	1,716	1,402	92,532
Total	8,849	594,034	1,158	76,428	205	13,530	10,212	673,992

PRICE OF GOLD, 1948.

The official prices of gold for the year were as follows:

Gold of 900 fineness and above .. \$69.40 per fine oz.

Gold of below 900 fineness .. \$68.55 per fine oz.

(*Gazette* Notification No. 2252 of 26-9-1946 and *Gazette* Notification No. 5408 of 14-8-1947.)

SCHEELITE.

(CALCIUM TUNGSTATE.)

The small tonnage produced during the year was from Kramat Pulai Ltd. in Kinta District, Perak, and was obtained from small scale operations and dump retreatment. Total production from this mine was 8,745 tons since 1929.

TABLE 18.

Year.	Production. Tons.	Value. \$	Year.	Production. Tons.	Value. \$
1909 ..	1 ..	346	1929 ..	275 ..	214,010
1910 ..	2 ..	700	1930 ..	792 ..	521,741
1911 ..	1.5 ..	1,368	1931 ..	368 ..	190,051
1912 ..	3 ..	1,796	1932 ..	302 ..	96,350
1913 ..	18 ..	16,776	1933 ..	918 ..	340,760
1914 ..	29 ..	25,213	1934 ..	1,508 ..	1,594,754
1915 ..	57 ..	70,945	1935 ..	1,365 ..	1,608,714
1916 ..	204 ..	312,557	1936 ..	1,364 ..	1,592,838
1917 ..	340 ..	568,286	1937 ..	836 ..	1,238,065
1918 ..	112 ..	187,200	1938 ..	573 ..	737,020
1919 ..	228 ..	227,571	1939 ..	174 ..	192,936
1920 ..	120 ..	97,143	1940 ..	56 ..	88,320
1921 ..	— ..	—	1941* ..	13 ..	21,600
1922 ..	0.4 ..	138	1942 ..	16 ..	—
1923 ..	— ..	—	1943 ..	52 ..	—
1924 ..	89 ..	69,944	1944 ..	83 ..	—
1925 ..	27 ..	8,973	1945 ..	10 ..	—
1926 ..	40 ..	27,727	1946 ..	— ..	—
1927 ..	— ..	—	1947 ..	11 ..	—
1928 ..	— ..	—			

* January-September.

JANUARY TO DECEMBER, 1948.

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1948. PRODUCTION.

				<i>B. forward</i> .. 12 tons			
January	..	2	tons	July	..	2	..
February	..	1	..	August	..	3	..
March	..	2	..	September	..	3	..
April	..	3	..	October	..	4	..
May	..	2	..	November	..	3	..
June	..	2	..	December	..	2	..
<i>C. forward</i> .. 12 ..				Total .. 29 ..			

Exports.

Year.		Tons.		Value.
				\$
1947	..	2.40	..	4,449
1948	..	27.66	..	115,857

WOLFRAMITE.

(IRON-MANGANESE TUNGSTATE.)

This occurs in several localities and has been mined in Kedah, Trengganu and Pahang. Elsewhere it has been obtained as a by-product of tin mining.

Mining is at present on a very small scale.

TABLE 19.

Year.	Tons.					Total.
	Kedah.	Perak.	Pahang.	Trengganu.		
1913-1917	207	---	---	841		1,048
1918-1922	927	---	---	1,505		2,432
1923-1927	492	---	---	707		1,199
1928-1932	602	---	---	270		872
1933-1937	565	---	---	350		915
1938	169	---	---	120		289
1939	174	---	---	140		314
1940	124	---	---	152		276
1942	---	---	19.8	---		19.8
1943 }	59.5	0.1	(21.5	33.7		---
1944 }			(29	54.7		---
1945	---	---	---	---		---
1946	---	---	---	---	Sel.	---
1947	2	---	3	27	1	33
1948	11.78	---	---	31.84	2.12	45.74

1948. PRODUCTION.

				<i>B. forward</i> .. 21 tons			
January	..	4	tons	July	..	4	..
February	..	5	..	August	..	5	..
March	..	3	..	September	..	3	..
April	..	4	..	October	..	4	..
May	..	2	..	November	..	2	..
June	..	3	..	December	..	7	..
<i>C. forward</i> .. 21 ..				Total .. 46 ..			

Exports.

Year.		Tons.		Value.
				\$
1947	..	40.50	..	53,077
1948	..	52	..	117,984

JANUARY TO DECEMBER, 1948.

IRON-ORE.

Iron-ore deposits have been worked at Sri Medan and Bukit Langkap in Johore, Bukit Besi and Machan Stahun in Trengganu and Temangan in Kelantan. Of these deposits all excepting Bukit Besi and Temangan have been practically worked out.

Other deposits of iron-ore exist in Malaya, but they have not yet been developed.

Exports of the stockpile of ore at the ex-Japanese mine at Bukit Besi, Dungun, Trengganu, started in August, 1948, and 70,472 tons of the stockpile have since been exported. It is hoped that the rehabilitation of this mine will start in the near future.

TABLE 20.
PRODUCTION OF IRON-ORE IN MALAYA, 1921-1948.
Tons.

Year.	Perak.	Johore.	Kelantan.	Trengganu.	Total Malaya.
1921	—	74,250 ..	—	—	74,250
1922	—	111,367 ..	—	—	111,367
1923	—	154,161 ..	—	—	154,161
1924	—	235,118 ..	—	—	235,118
1925	—	271,992 ..	—	7,690 ..	279,682
1926	—	250,100 ..	—	45,511 ..	295,611
1927	—	409,242 ..	—	48,505 ..	457,747
1928	—	584,588 ..	—	25,927 ..	610,515
1929	—	743,209 ..	—	55,150 ..	798,359
1930	—	729,251 ..	—	87,364 ..	816,615
1931	—	488,877 ..	—	203,109 ..	691,986
1932	—	485,067 ..	—	203,105 ..	688,172
1933	—	408,644 ..	—	357,833 ..	766,477
1934	—	578,180 ..	—	557,468 ..	1,135,648
1935	—	594,891 ..	—	816,744 ..	1,411,635
1936	449 ..	590,288 ..	—	1,064,259 ..	1,654,996
1937	1,147 ..	519,339 ..	49,223 ..	991,119 ..	1,560,828
1938	923 ..	549,960 ..	159,900 ..	905,316 ..	1,616,099
1939	768 ..	681,886 ..	210,930 ..	1,048,937 ..	1,942,521
1940	957 ..	625,550 ..	226,241 ..	1,109,715 ..	1,962,463
1941 (Jan.-Sept.) ..	715 ..	314,005 ..	154,697 ..	680,275 ..	1,148,977
1942	116 ..	—	—	90,660 ..	90,776
1943	17,843 ..	—	—	30,718 ..	48,361
1944	10,441 ..	—	11 ..	1 ..	10,453
1945	13,375 ..	—	—	—	13,375
1946	—	—	—	—	—
1947	888* ..	—	—	—	888
1948—					
January	46 ..	—	—	—	46
February	55 ..	—	—	—	55
March	53 ..	—	—	—	53
April	57 ..	—	—	—	57
May	64 ..	—	—	—	64
June	43 ..	—	—	—	43
July	27 ..	—	—	—	27
August	39 ..	—	—	—	39
September	32 ..	—	—	—	32
October	95 ..	—	—	—	95
November	65 ..	—	—	—	65
December	65 ..	—	—	—	65
Total	641*	—	—	—	641

Year.	Exports, Tons.	Value, \$
1947 ..	22 ..	784
1948 ..	71,113 ..	607,486

* Used locally for jig raggings on dredges.

MANGANESE-ORES.

The economic deposits known in Malaya prior to the war are confined to the States of Kelantan and Trengganu and were mined by Japanese Companies which exported the ore to Japan.

The deposit at Kemaman, in the State of Trengganu, is now practically worked out.

Typical analyses of the ores mined are as follows:

State.	Manganese.	Iron.	Silica.	Phosphorus.	Sulphur.	Copper.
	%	%	%	%	%	%
Kelantan ..	44-46 ..	3-6 ..	5-7 ..	0.063-0.08 ..	0.003 ..	0.008 ..
Trengganu ..	15-25 ..	24-30 ..	— ..	— ..	— ..	— ..

TABLE 21.

PRODUCTION AND EXPORTS OF MANGANESE-ORE FROM MALAYA.

Year.	Kelantan.	Trengganu.	Total production.	Total exports
	Tons.	Tons.	Tons.	Tons.
1925-29 ..	— ..	182,789 ..	182,789 ..	— ..
1930-34 ..	11,844 ..	58,780 ..	70,664 ..	— ..
1935 ..	10,878 ..	17,367 ..	28,045 ..	28,045 ..
1936 ..	10,006 ..	26,770 ..	36,776 ..	36,776 ..
1937 ..	9,667 ..	23,126 ..	32,793 ..	32,793 ..
1938 ..	8,916 ..	23,054 ..	31,970 ..	31,970 ..
1939 ..	11,548 ..	19,900 ..	31,448 ..	31,448 ..
1940 ..	3,141 ..	8,400 ..	11,541 ..	? ..
1941 ..	3,635* ..	— ..	3,635* ..	? ..
1942-45 ..	900 ..	10,000 ..	10,900 ..	3,000 ..

TANTALITE-COLUMBITE.

The usual primary occurrence of Tantalite (tantarate of iron and manganese) and Columbite (columbate of iron and manganese) is in pegmatite veins, but being heavy, resistant to chemical change and to abrasion, they occur frequently in alluvial and eluvial deposits.

Alluvial tin-ore deposits at Bakri, Johore, containing a small proportion of Tantalite-Columbite have excited some interest and it is likely that gravel pumping operations will start during the ensuing year.

TANTALITE-COLUMBITE PRODUCTION, 1942-1945.

Johore	3 tons
Kedah	2 „
Total	5 tons approx.

COPPER ORES.

No economic deposits are known in Malaya, although the Japanese mined a small quantity at Sungei Lembing, Pahang.

During the period 1942-1945, approximately 160 tons of metallic copper were produced.

LEAD ORES.

No large deposits are known though there are widespread minor occurrences. In the past galena was mined in the Langkawi Islands and near Taiping, Perak.

PRODUCTION.

1942-1945 ..	152 tons approximately from Selangor.
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* Figures for January-September inclusive only.

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BAUXITE.

(HYDRATED OXIDE OF ALUMINIUM.)

This was mined for export to Japan between 1938 and 1945 in four localities in Johore and one in Malacca. It is known to occur in other areas, and it is hoped that as a result of recent prospecting, production will be resumed in the near future.

A deposit of ore of good grade and large extent has been proved in south-east Johore but mining leases have not yet been issued.

TABLE 22.
PRODUCTION.

		Tons.			
Year.		Johore.	Malacca.		Total.
1936	..	36	..	..	36
1937	..	19,000	..	..	19,000
1938	..	55,081	..	..	55,081
1939	..	92,256	..	..	92,256
1940	..	62,779	..	..	62,779
1941	..	50,824	..	..	50,824
1942-45	..	225,450*	..	170,000*	395,450*
1946	..	—	..	..	—
1947	..	—	..	..	—
1948	..	—	..	..	—

ILMENITE.

(IRON-TITANIUM OXIDE.)

Ilmenite forms the chief constituent of "amang", a product obtained during the final process of cleaning tin-ore concentrates. Dredging companies and large open-cast mines effect the separation of amang from tin-ore by means of magnetic separators, smaller mines by washing in sluice boxes and dulangs.

To be saleable the amang should contain about 50% TiO_2 and United Kingdom buyers prefer a greater proportion of ferrous to ferric iron.

The mineral is largely used in the preparation of titanium paints.

TABLE 23.
"ILMENITE" EXPORTS AND VALUE.

Year.	Exports. Tons.	Value.† \$	Year.	Exports. Tons.	Value.† \$
1935..	2,431	7,371	1948—		
1936..	10,331	26,803	January ..	1,600	1,600
1937..	6,252	13,423	February..	1,510	1,510
1938..	6,462	16,155	March ..	15	15
1939..	11,098	27,614	April ..	500	500
1940..	2,555	2,555	May ..	—	—
1941 (Jan.-			June ..	2,030	2,030
Sept.) ..	44	461	July ..	2,000	2,000
1946..	Nil		August ..	715	715
1947..	13,081	13,081	September	1,250	1,250
			October ..	1,000	1,000
			November	1,250	1,250
			December	1,696	1,696
			Total ..	13,566	13,566

* Approximate figures only.

† The value for assessment of Export Duty is fixed at \$1 a ton.

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KAOLIN.

CHINA CLAY.

(HYDRATED ALUMINIUM SILICATE.)

Kaolin is mined on a small scale near Tapah in Perak and at Cheras in Selangor for local use as filler in the manufacture of rubber articles. Large supplies are available in the Gopeng, Tronoh and Bidor districts of Perak, and there are other deposits elsewhere, but a limited quantity is sufficient for present local purposes.

TABLE 24.

Year.	Production. Tons.	Value. \$	Year.	Production. Tons.	Value. \$
1923..	451	13,556	1948—		
1924..	830	36,335	January ..	94	} Not known.
1925..	8.8	508	February ..	56	
1926..	—	—	March ..	81	
1927..	6.8	308	April ..	86	
1928..	—	—	May ..	95	
1929..	—	—	June ..	106	
1930..	—	—	July ..	74	
1931..	0.22	4	August ..	63	
1932..	5	125	September ..	81	
1933..	153	3,825	October ..	80	
1934..	164	4,100	November ..	40	
1935..	91	2,275	December ..	67	
1936..	121	3,025			
1937..	293	7,325	Total ..	923	
1938..	1,153	28,825			
1939..	494	12,350			
1940..	408	8,172			
1941 (Jan.-					
Sept.) ..	823	16,201			
1942..	—	—			
1943..	—	—			
1944..	—	—			
1945..	—	—			
1946..	241	—			
1947..	1,003	—			

Exports.

Year.	Tons.	Value. \$
1947 ..	111.29	8,104
1948 ..	36	2,939

IV.—LABOUR.

Of the races employed in mining, the Chinese predominate, Indians, Malays and others together forming only a small proportion of the total.

Wages show a great increase over the pre-war levels, and the cost of feeding the labourers (which is the usual practice on Chinese mines), has increased enormously owing to the price of additional food with which they insist on being supplied to supplement the entirely inadequate rice ration.

Labour was unsettled during the first part of the year, up to the commencement of the emergency, when action against Communists caused many of the union leaders to go underground, which resulted in a great reduction in strikes and labour disturbances thenceforth. In fact, since the commencement of the emergency, there has been a total absence of strikes amongst mine labourers.

The Mining Employers' Association continued negotiations with Trade Unions on wages and working conditions to the benefit of the Industry.

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TABLE 25.

CENSUS.

Year. (End of)	Perak.	Selangor.	Negri Sembilan.	Pahang.	Total.
1929	65,411	31,346	2,424	5,287	104,468
1930	50,876	23,288	1,523	4,841	80,528
1931	33,486	18,990	1,129	3,433	57,038
1932	23,736	16,275	904	3,540	44,455
1933	24,043	14,145	660	4,014	42,862
1934	31,550	17,522	1,156	4,391	54,619
1935	32,596	23,224	1,301	5,723	62,844
1936	44,284	27,841	1,752	6,341	80,218
1937	47,530	31,960	2,273	6,522	88,285
1938	30,641	19,297	1,697	6,028	57,663
1939	41,636	23,195	2,470	5,653	72,954
1940	52,606	28,574	2,839	7,126	91,145
1941 (Sept.) ..	47,514	28,966	2,807	7,512	86,799

Year.	Perak.	Selangor.	Negri Sembilan.	Pahang.	Johore.	Treng- ganu.	Kedah.	Perlis.	Malacca.	Total.
1946	13,171	8,564	682	2,134	429	619	150	270	—	26,019
1947	23,451	12,869	1,443	2,556	475	927	394	521	212	42,748
1948—										
(End of)										
January	23,937	13,137	1,524	2,650	520	882	408	529	222	43,809
February	24,448	13,412	1,561	2,841	526	895	406	583	221	44,883
March	25,209	13,737	1,603	2,911	521	876	402	557	220	46,036
April	25,357	14,050	1,915	2,861	539	809	362	675	187	46,805
May	25,525	13,988	1,747	2,846	617	821	407	649	198	46,798
June	26,082	14,050	1,676	2,948	694	805	387	734	205	47,471
July	27,100	14,314	1,716	2,941	608	805	375	605	205	48,669
August	27,535	14,252	1,706	2,839	622	1,756	406	708	272	50,097
September ..	27,585	14,334	1,621	2,883	638	1,661	300	854	266	50,252
October	27,347	14,380	1,888	2,908	651	1,780	387	738	265	50,344
November ..	27,813	14,409	1,887	2,965	608	1,824	339	847	255	50,947
December ..	27,932	14,276	1,656	2,970	633	2,203	419	927	251	51,267

TABLE 26.

EMPLOYMENT.

Year. (End of)	Tin.	Coal.	Gold.	Miscellaneous.	Total.
1929	100,039	3,908	521	..	104,468
1930	76,796	3,182	550	..	80,528
1931	53,919	2,209	910	..	57,038
1932	41,014	2,584	857	..	44,455
1933	39,380	1,871	1,611	..	42,862
1934	50,464	2,627	1,528	..	54,619
1935	57,263	3,655	1,926	..	62,844
1936	73,468	4,783	1,967	..	80,218
1937	80,648	5,063	1,974	..	88,285
1938	50,402	4,043	2,862	356	57,663
1939	65,556	4,044	3,100	254	72,954
1940	82,527	4,993	3,517	108	91,145
1941 (Sept.) ..	77,712	5,909	3,031	147	86,799
1946	23,026	2,708	253	32	26,019
1947	39,362	2,813	529	44	42,748
1948—					
(End of)					
January	40,544	2,602	585	78	43,809
February	41,420	2,619	733	111	44,883
March	42,573	2,654	660	149	46,036
April	43,337	2,664	682	122	46,805
May	43,452	2,613	607	126	46,798
June	44,117	2,590	642	122	47,471
July	45,412	2,509	631	117	48,669
August	46,111	2,370	600	1,016	50,097
September ..	46,373	2,354	594	931	50,252
October	46,304	2,381	610	1,049	50,344
November ..	46,761	2,432	646	1,108	50,947
December ..	46,858	2,172	617	1,620	51,267

TABLE 27.

EMPLOYMENT BY RACES.

Year.	Chinese.	Indians.	Malays.	Europeans.	Other nationalities.	Total.
(End of)						
1935	58,451	7,505	3,808	395	159	70,318
1936	75,341	10,286	5,738	505	408	92,278
1937	83,114	13,645	5,720	560	468	103,507
1938	52,596	11,224	6,511	466	690	71,487
1939	65,840	13,610	7,125	588	888	88,051
1940	*	*	*	*	*	91,145†
1941	*	*	*	*	*	86,799†
1946	17,399	5,186	3,035	275	124	26,019
1947	30,076	6,447	4,742	436	1,047	42,748
1948—						
(Dec. 31st)						
Perak	19,308	3,750	4,364	232	278	27,932
Selangor	9,928	2,687	1,447	156	58	14,276
N. S'bilan	1,284	77	282	10	3	1,656
Pahang	2,171	119	575	48	57	2,970
Johore	537	16	75	3	2	633
Trengganu	598	157	1,438	10	—	2,203
Kedah	294	30	92	3	—	419
Kelantan	—	—	—	—	—	—
Perlis	912	—	15	—	—	927
Malacca	221	1	4	—	25	251
Total	35,253	6,837	8,292	462	423	51,267

* Indicates figures not available.
unclassified.

† Figures for 1940 and 1941 for Federated Malay States only and

TABLE 28A.

MONTHLY EMPLOYMENT OF LABOUR ON TIN MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF PERAK.

End of month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Under-ground.	Miscellaneous.	TOTAL.		Grand total.
								European Mines.	Chinese Mines.	
January	European Chinese	7,287 —	1,346 11,456	2,105 670	— —	— 145	180 721	10,918 —	— 12,991	23,909
February	European Chinese	7,525 —	1,408 11,697	2,091 652	— —	— 151	109 763	11,133 —	— 13,263	24,396
March	European Chinese	8,044 —	1,448 12,026	2,082 646	— —	— 133	109 663	11,663 —	— 13,473	25,156
April	European Chinese	7,931 —	1,397 12,421	2,109 649	— —	— 149	108 545	11,540 —	— 13,764	25,304
May	European Chinese	7,725 —	1,347 12,816	2,111 589	— —	— 208	75 599	11,258 —	— 14,207	25,465
June	European Chinese	7,807 —	1,387 13,217	2,137 595	— —	— 244	95 540	11,426 —	— 14,596	26,022
July	European Chinese	8,120 —	1,366 13,964	2,196 583	— —	— 268	90 453	11,772 —	— 15,268	27,040
August	European Chinese	8,411 —	1,360 14,111	2,222 569	— —	— 215	90 490	12,083 —	— 15,385	27,468
September	European Chinese	8,531 —	1,349 14,018	2,174 551	— —	— 269	110 463	12,164 —	— 15,301	27,465
October	European Chinese	8,553 —	1,382 13,735	2,206 544	— —	— 329	110 418	12,251 —	— 15,026	27,277
November	European Chinese	8,611 —	1,298 14,322	2,215 506	— —	— 215	84 487	12,206 —	— 15,530	27,738
December	European Chinese	8,663 —	1,300 14,372	2,219 655	— —	— 103	98 452	12,275 —	— 15,582	27,857

TABLE 28B.

MONTHLY EMPLOYMENT OF LABOUR ON TIN MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF SELANGOR.

End of month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Under-ground.	Miscellaneous.	TOTAL.		Grand total.
								European Mines.	Chinese Mines.	
January	European	4,451	191	—	633	—	3	5,278	—	10,517
	Chinese	—	4,709	69	391	—	70	—	5,239	
February	European	4,508	171	—	635	—	—	5,314	—	10,775
	Chinese	—	4,952	56	390	—	63	—	5,461	
March	European	4,640	167	—	635	—	—	5,442	—	11,065
	Chinese	—	5,126	58	390	—	49	—	5,623	
April	European	4,732	153	—	626	—	—	5,511	—	11,369
	Chinese	—	5,392	58	393	—	15	—	5,852	
May	European	4,576	197	—	630	—	—	5,403	—	11,360
	Chinese	—	5,459	67	393	—	38	—	5,957	
June	European	4,593	204	—	646	—	—	5,443	—	11,445
	Chinese	—	5,508	67	393	—	34	—	6,002	
July	European	4,893	211	—	651	—	—	5,755	—	11,790
	Chinese	—	5,559	67	394	—	15	—	6,035	
August	European	4,897	208	—	652	—	—	5,757	—	11,873
	Chinese	—	5,640	67	394	—	15	—	6,116	
September	European	5,096	230	—	651	—	—	5,977	—	11,969
	Chinese	—	5,540	41	397	—	14	—	5,992	
October	European	5,140	233	—	651	—	—	6,024	—	11,986
	Chinese	—	5,500	41	395	—	26	—	5,962	
November	European	5,096	258	—	634	—	—	5,988	—	11,968
	Chinese	—	5,479	46	435	—	20	—	5,980	
December	European	5,220	258	—	613	—	—	6,091	—	12,094
	Chinese	—	5,498	46	450	—	9	—	6,003	

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TABLE 28c.

MONTHLY EMPLOYMENT OF LABOUR ON TIN MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF NEGERI SEMBILAN.

End of month.	Mine.	Dredging.	Gravel Pumping.	Hydrau- licing.	Open Cast.	Under- ground.	Miscel- laneous.	TOTAL.		Grand total.
								European Mines.	Chinese Mines.	
January	European Chinese	739 —	— 745	32 —	8 —	— —	— —	739 —	— 785	1,524
February	European Chinese	752 —	— 764	32 —	8 —	— —	5 —	752 —	— 809	1,561
March	European Chinese	802 —	— 775	18 —	8 —	— —	— —	802 —	— 801	1,603
April	European Chinese	1,043 —	— 845	19 —	8 —	— —	— —	1,043 —	— 872	1,915
May	European Chinese	848 —	— 870	21 —	8 —	— —	— —	848 —	— 899	1,747
June	European Chinese	831 —	— 817	20 —	8 —	— —	— —	831 —	— 845	1,676
July	European Chinese	846 —	— 842	20 —	8 —	— —	— —	846 —	— 870	1,716
August	European Chinese	849 —	— 829	20 —	8 —	— —	— —	849 —	— 857	1,706
September	European Chinese	844 —	— 783	17 —	8 —	— —	89 —	844 —	— 847	1,691
October	European Chinese	1,081 —	— 709	17 —	8 —	— —	73 —	1,081 —	— 807	1,888
November	European Chinese	1,101 —	— 675	17 —	8 —	— —	86 —	1,101 —	— 796	1,887
December	European Chinese	965 —	— 612	17 —	8 —	— —	54 —	965 —	— 691	1,656

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TABLE 28D.

MONTHLY EMPLOYMENT OF LABOUR ON TIN MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF PAHANG.

End of month.	Mine.	Dredging.	Gravel Pumping.	Hydrau- licing.	Open Cast.	Under- ground.	Miscel- laneous.	TOTAL.		Grand total.
								European Mines.	Chinese Mines.	
January	European Chinese	— —	— 167	— —	— —	1,894 —	— 4	1,894 —	— 171	2,065
February	European Chinese	— —	— 171	— —	— —	1,932 —	— 5	1,932 —	— 176	2,108
March	European Chinese	— —	— 172	— —	— —	1,914 —	60 5	1,974 —	— 177	2,151
April	European Chinese	— —	— 183	— —	— —	1,927 —	64 5	1,991 —	— 188	2,179
May	European Chinese	— —	— 218	— —	— —	1,944 —	67 10	2,011 —	— 228	2,239
June	European Chinese	— —	— 291	— —	— —	1,950 —	55 10	2,005 —	— 301	2,306
July	European Chinese	— —	— 341	— —	— —	1,903 —	58 10	1,959 —	— 351	2,310
August	European Chinese	— —	— 354	— —	— —	1,860 —	15 10	1,875 —	— 364	2,239
September	European Chinese	— —	— 291	— —	— —	1,915 —	64 19	1,979 —	— 310	2,289
October	European Chinese	— —	— 295	— —	— —	1,913 —	66 24	1,979 —	— 319	2,298
November	European Chinese	— —	— 297	— —	— —	1,933 —	65 24	1,998 —	— 321	2,319
December	European Chinese	— —	— 341	— —	— —	1,935 —	57 20	1,992 —	— 361	2,353

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TABLE 28E.
MONTHLY EMPLOYMENT OF LABOUR ON TIN MINES, 1948, BY STATES AND METHODS OF MINING.
STATE OF JOHORE.

End of month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Underground.	Miscellaneous.	TOTAL.		Grand total.
								European Mines.	Chinese Mines.	
January	European Chinese	239 —	— 274	— —	— —	— —	— 7	239 —	— 281	520
February	European Chinese	235 —	— 243	— —	— —	— —	— 7	235 —	— 250	485
March	European Chinese	236 —	— 332	— —	— —	— —	— 7	236 —	— 339	575
April	European Chinese	235 —	— 327	— —	— —	— —	— 7	235 —	— 334	569
May	European Chinese	237 —	— 360	— —	— —	— —	— —	237 —	— 360	597
June	European Chinese	238 —	— 351	— —	— —	— —	— —	238 —	— 351	589
July	European Chinese	248 —	— 345	— —	— —	— —	— —	248 —	— 345	593
August	European Chinese	274 —	— 317	— 16	— —	— —	— —	274 —	— 333	607
September	European Chinese	277 —	— 327	— 19	— —	— —	— —	277 —	— 346	623
October	European Chinese	257 —	— 357	— 22	— —	— —	— —	257 —	— 379	636
November	European Chinese	243 —	— 334	— 26	— —	— —	— —	243 —	— 360	603
December	European Chinese	244 —	— 349	— 35	— —	— —	— —	244 —	— 384	628

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TABLE 28F.

MONTHLY EMPLOYMENT OF LABOUR ON TIN MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF TRENGGANU.

End of month.	Mine.	Dredging.	Gravel Pumping.	Hydrau- licing.	Open Cast.	Under- ground.	Miscel- laneous.	TOTAL.		Grand total.
								European Mines.	Chinese Mines.	
January	European Chinese	— —	— 636	— —	— —	— 116	— 93	— —	— 850	850
February	European Chinese	— —	— 683	— —	— 7	— 153	— 10	— —	— 853	853
March	European Chinese	— —	— 638	— —	— 12	— 134	— 60	— —	— 844	844
April	European Chinese	— —	— 631	— —	— 12	— 102	— 32	— —	— 777	777
May	European Chinese	— —	— 611	— —	— 16	— 129	— 34	— —	— 790	790
June	European Chinese	— —	— 611	— —	— 16	— 127	— 19	— —	— 773	773
July	European Chinese	— —	— 170	— —	— —	— 91	— 517	— —	— 778	778
August	European Chinese	— —	— 170	— —	— —	— 93	— 568	— —	— 831	831
September	European Chinese	— —	— 167	— —	— —	— 77	— 582	— —	— 826	826
October	European Chinese	— —	— 630	— —	— —	— 150	— 49	— —	— 829	829
November	European Chinese	— —	— 630	— —	— —	— 147	— 28	— —	— 805	805
December	European Chinese	— —	— 480	— —	— —	— 162	— 31	— —	— 673	673

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TABLE 28G.
MONTHLY EMPLOYMENT OF LABOUR ON TIN MINES, 1948, BY STATES AND METHODS OF MINING.
STATE OF KEDAH.

End of month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Under-ground.	Miscellaneous.	TOTAL.		Grand total.
								European Mines.	Chinese Mines.	
January	European Chinese	104	76	—	228	—	—	104	304	408
February	European Chinese	106	76	—	224	—	—	106	300	406
March	European Chinese	106	79	—	217	—	—	106	296	402
April	European Chinese	106	86	—	170	—	—	106	256	362
May	European Chinese	117	55	—	235	—	—	117	290	407
June	European Chinese	120	59	—	188	—	—	120	247	367
July	European Chinese	125	74	—	176	—	—	125	250	375
August	European Chinese	117	117	—	172	—	—	117	289	406
September	European Chinese	127	116	—	147	—	—	127	263	390
October	European Chinese	127	112	—	148	—	—	127	260	387
November	European Chinese	140	94	—	106	—	—	140	199	339
December	European Chinese	140	113	—	166	—	—	140	279	419

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TABLE 28H.

MONTHLY EMPLOYMENT OF LABOUR ON TIN MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF PERLIS.

End of Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Under-ground.	Miscellaneous.	TOTAL.		Grand Total.
								European Mines.	Chinese Mines.	
January	European Chinese	— —	— —	— 22	— —	— 507	— —	— —	— 529	529
February	European Chinese	— —	— 36	— 22	— —	— 525	— —	— —	— 583	583
March	European Chinese	— —	— —	— —	— —	— 557	— —	— —	— 557	557
April	European Chinese	— —	— —	— —	— 29	— 646	— —	— —	— 675	675
May	European Chinese	— —	— —	— 22	— 10	— 617	— —	— —	— 649	649
June	European Chinese	— —	— —	— 22	— 10	— 702	— —	— —	— 734	734
July	European Chinese	— —	— 44	— 22	— 8	— 531	— —	— —	— 605	605
August	European Chinese	— —	— 39	— 22	— 6	— 641	— —	— —	— 708	708
September	European Chinese	— —	— —	— 14	— 6	— 834	— —	— —	— 854	854
October	European Chinese	— —	— 19	— 14	— 6	— 699	— —	— —	— 738	738
November	European Chinese	— —	— 30	— 14	— 6	— 797	— —	— —	— 847	847
December	European Chinese	— —	— 34	— 12	— 8	— 873	— —	— —	— 927	927

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TABLE 281.

MONTHLY EMPLOYMENT OF LABOUR ON TIN MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF MALACCA.

End of Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Underground.	Miscellaneous.	TOTAL.		Grand Total.
								European Mines.	Chinese Mines.	
January	European Chinese	—	— 153	—	— 38	—	— 31	—	— 222	222
February	European Chinese	—	— 153	—	— 38	—	— 30	—	— 221	221
March	European Chinese	—	— 153	—	— 38	—	— 29	—	— 220	220
April	European Chinese	—	— 185	—	— 38	—	— 14	—	— 187	187
May	European Chinese	—	— 142	—	— 38	—	— 18	—	— 198	198
June	European Chinese	—	— 149	—	— 38	—	— 18	—	— 205	205
July	European Chinese	—	— 149	—	— 38	—	— 18	—	— 205	205
August	European Chinese	—	— 219	—	— 38	—	— 16	—	— 273	273
September	European Chinese	—	— 210	—	— 38	—	— 18	—	— 266	266
October	European Chinese	—	— 209	—	— 38	—	— 18	—	— 265	265
November	European Chinese	—	— 199	—	— 38	—	— 18	—	— 255	255
December	European Chinese	—	— 195	—	— 38	—	— 18	—	— 251	251

V.—MACHINERY.

Prime movers on mines are now seldom operated by steam, except on a diminishing number of dredges, and while gravel pump mines are the main users of oil engines, both they and dredges consume a considerable quantity of electric power.

The capacity of electrical generating stations has been increased during the year but is still below the pre-war figure. In addition, there is a shortage of electrical equipment, and this has, in a number of cases, hindered the rehabilitation of mines.

Since the end of the war a very large amount of scattered plant has been identified and handed back to the owners, and in addition Diesel engines totalling 43,060 h.p. have been acquired by Government for sale to industry and nearly all of this has now been allocated, mainly to mines. Many oil-engines damaged as part of the "scorched-earth" policy during the Malayan Campaign have been repaired.

A considerable amount of machinery and engineering stores in general are still urgently required for the rehabilitation of the mines, as delivery dates have often been postponed with resulting delay in getting the mining industry back to normal.

TABLE 29.

CLASSIFICATION.

Year. (End of)	ACTIVE H.P.					
	Steam.	Oil.	Electric.	Gas.	Hydraulic.	Total.
1929	42,657	57,453	57,794	2,129	20,119	180,152
1930	36,385	50,293	73,715	500	18,977	169,870
1931	22,374	36,809	55,053	329	17,875	132,440
1932	28,109	29,132	56,770	135	17,477	131,623
1933	19,185	28,125	43,696	250	19,496	110,752
1934	24,026	35,495	74,772	390	19,382	154,065
1935	25,434	33,644	86,170	424	21,323	171,995
1936	30,810	65,102	117,482	375	19,577	233,346
1937	35,905	106,410	129,974	484	20,321	293,124
1938	20,252	66,327	113,910	135	22,765	223,389
1939	27,173	94,460	121,409	284	20,060	263,386
1940	30,554	128,060	156,228	210	20,895	335,947
1941 (Sept.) ..	29,433	131,183	151,244	210	18,401	330,471
1946	4,106	14,368	43,256	—	5,763	67,493
1947	14,982	62,248	82,675	—	10,189	170,094
1948— (End of)						
January	14,793	66,670	83,328	—	15,570	180,361
February	15,859	63,914	85,983	—	15,439	186,195
March	18,169	72,780	88,999	—	15,564	195,512
April	19,295	78,665	89,869	—	15,917	203,746
May	18,715	80,675	92,304	—	15,984	207,678
June	19,389	84,468	94,910	—	15,799	214,566
July	19,359	90,597	96,827	—	15,875	222,658
August	17,969	95,124	97,864	—	15,324	226,281
September	17,969	97,423	97,616	—	15,831	228,839
October	17,969	101,097	99,299	—	16,050	234,415
November	18,330	104,910	99,940	—	15,863	239,043
December	18,126	106,072	104,865	—	15,683	244,746

TABLE 30A.

ACTIVE HORSE POWER ON MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF PERAK.

End of Month.	Minc.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Under-ground.	Miscellaneous.	TOTAL.		Grand Total.
								European Mines.	Chinese Mines.	
January	European Chinese	32,925 —	5,011 54,244	14,364 4,399	— —	— —	30 92	52,330 —	— 58,735	111,065
February	European Chinese	34,117 —	5,050 55,561	14,215 4,317	— —	— —	10 89	53,392 —	— 59,967	113,359
March	European Chinese	36,151 —	5,043 57,647	14,217 4,422	— —	— —	10 76	55,421 —	— 62,145	117,566
April	European Chinese	37,412 —	4,975 59,398	14,643 4,547	— —	— —	10 129	57,040 —	— 64,544	121,584
May	European Chinese	37,220 —	5,052 61,731	14,724 4,287	— —	— —	10 213	57,006 —	— 66,231	123,237
June	European Chinese	37,633 —	5,102 65,286	14,512 4,548	— —	— —	10 348	57,257 —	— 70,182	127,439
July	European Chinese	38,535 —	5,101 70,469	14,649 4,577	— —	— —	10 412	58,294 —	— 75,458	133,752
August	European Chinese	38,532 —	5,101 72,251	14,662 4,618	— —	— —	10 412	57,706 —	— 77,281	134,986
September	European Chinese	39,181 —	5,181 72,872	14,598 4,631	— —	— —	20 612	58,980 —	— 78,115	137,095
October	European Chinese	39,182 —	5,183 73,743	14,782 4,684	— —	— —	20 871	59,172 —	— 79,298	138,470
November	European Chinese	39,067 —	5,099 76,732	14,727 4,441	— —	— —	10 814	58,903 —	— 81,967	140,890
December	European Chinese	40,761 —	5,279 78,573	14,685 4,563	— —	— —	10 934	60,735 —	— 84,070	144,805

NOTE.—Hydraulic horse power includes hydraulic elevators and monitors.

TABLE 30B.

ACTIVE HORSE POWER ON MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF SELANGOR.

End of Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Underground.	Miscellaneous.	TOTAL.		Grand Total.
								European Mines.	Chinese Mines.	
January	European Chinese	14,806 —	852 23,213	— 220	1,605 1,471	7,865 —	—	25,128 —	— 24,904	50,032
February	European Chinese	17,096 —	939 24,125	— 220	2,155 1,476	7,698 —	—	27,883 —	— 25,821	53,709
March	European Chinese	18,803 —	939 24,470	— 220	2,215 1,876	8,896 —	—	30,853 —	— 26,566	57,419
April	European Chinese	19,994 —	944 26,013	— 220	2,215 1,876	10,028 —	—	33,181 —	— 28,100	61,290
May	European Chinese	21,572 —	1,204 26,598	— 220	2,215 1,921	9,733 —	—	34,724 —	— 28,739	63,463
June	European Chinese	21,448 —	1,249 27,288	— 192	2,255 1,921	11,084 —	—	36,036 —	— 29,401	65,437
July	European Chinese	21,618 —	1,319 28,028	— 192	2,255 1,881	10,885 —	65	36,077 —	— 30,166	66,243
August	European Chinese	21,674 —	1,319 29,062	— 192	2,255 1,881	9,732 —	—	34,980 —	— 31,135	66,115
September	European Chinese	20,675 —	1,319 29,891	— 192	2,355 2,081	9,882 —	—	34,231 —	— 32,164	66,395
October	European Chinese	22,278 —	1,319 30,003	— 220	2,770 1,641	10,128 —	—	36,495 —	— 31,864	68,359
November	European Chinese	23,267 —	1,555 30,287	— 220	2,770 2,116	9,661 —	—	37,253 —	— 32,623	69,876
December	European Chinese	24,571 —	1,590 31,237	— 220	2,770 1,971	9,947 —	—	38,878 —	— 33,428	72,306

NOTE.—Hydraulic horse power includes hydraulic elevators and monitors.

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TABLE 30c.
ACTIVE HORSE POWER ON MINES, 1948, BY STATES AND METHODS OF MINING.
STATE OF NEGRI SEMBILAN.

End of Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Underground.	Miscellaneous.	TOTAL.		Grand Total.
								European Mines.	Chinese Mines.	
January	European Chinese	1,850 —	— 3,432	— 135	— —	— —	— —	1,850 —	— 3,567	5,428
February	European Chinese	1,952 —	— 3,373	— 135	— —	— —	— —	1,952 —	— 3,508	5,460
March	European Chinese	1,952 —	— 3,611	— 135	— —	— —	— —	1,952 —	— 3,746	5,698
April	European Chinese	1,942 —	— 3,851	— 135	— —	— —	— —	1,942 —	— 3,986	5,928
May	European Chinese	1,967 —	— 3,586	— 135	— —	— —	— —	1,967 —	— 3,721	5,688
June	European Chinese	1,967 —	— 3,706	— 135	— —	— —	— —	1,967 —	— 3,841	5,808
July	European Chinese	1,967 —	— 3,856	— 135	— —	— —	— —	1,967 —	— 3,991	5,958
August	European Chinese	1,967 —	— 4,174	— 135	— —	— —	— —	1,967 —	— 4,309	6,276
September	European Chinese	1,967 —	— 3,936	— 135	— —	— —	265	1,967 —	— 4,336	6,303
October	European Chinese	1,967 —	— 4,215	— 135	— —	— —	265	1,967 —	— 4,615	6,582
November	European Chinese	1,979 —	— 4,345	— —	— —	— —	265	1,979 —	— 4,610	6,589
December	European Chinese	1,979 —	— 3,909	— —	— —	— —	265	1,979 —	— 3,874	5,853

NOTE.—Hydraulic horse power includes hydraulic elevators and monitors.

TABLE 30D.
ACTIVE HORSE POWER ON MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF PAHANG.

End of Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Underground.	Miscellaneous.	TOTAL.		Grand Total.
								European Mines.	Chinese Mines.	
January	European Chinese	— —	— 1,100	— 69	— 2	7,738 —	— —	7,738 —	— 1,171	8,959
February	European Chinese	— —	— 1,190	— 69	— 2	7,738 —	— —	7,738 —	— 1,171	8,959
March	European Chinese	— —	— 1,220	— 69	— 2	8,538 —	— —	8,538 —	— 1,291	9,829
April	European Chinese	— —	— 975	— 69	— 2	8,538 —	— —	8,538 —	— 1,046	9,584
May	European Chinese	— —	— 1,095	— —	— 2	8,689 —	— 42	8,731 —	— 1,097	9,828
June	European Chinese	— —	— 1,276	— —	— 2	8,854 —	— 42	8,896 —	— 1,278	10,174
July	European Chinese	— —	— 1,476	— —	— 2	8,854 —	— 42	8,896 —	— 1,478	10,374
August	European Chinese	— —	— 1,476	— —	— 2	9,039 —	— 42	9,081 —	— 1,478	10,559
September	European Chinese	— —	— 1,476	— —	— 2	9,039 —	— 42	9,081 —	— 1,478	10,559
October	European Chinese	— —	— 1,476	— —	— —	9,032 —	— 42	9,074 —	— 1,476	10,550
November	European Chinese	— —	— 1,536	— —	— —	9,060 —	— 42	9,102 —	— 1,586	10,633
December	European Chinese	— —	— 1,786	— —	— —	9,056 —	— 42	9,098 —	— 1,786	10,884

NOTE.—Hydraulic horse power includes hydraulic elevators and monitors.

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TABLE 30E.
ACTIVE HORSE POWER ON MINES, 1948, BY STATES AND METHODS OF MINING.
STATE OF JOHORE.

End of Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Underground.	Miscellaneous.	TOTAL.		Grand Total.
								European Mines.	Chinese Mines.	
January	European Chinese	1,064 —	— 797	— —	— —	— —	— —	1,064 —	— 797	1,861
February	European Chinese	1,064 —	— 407	— —	— —	— —	— —	1,064 —	— 407	1,471
March	European Chinese	1,064 —	— 595	— —	— —	— —	— —	1,064 —	— 595	1,659
April	European Chinese	1,064 —	— 595	— —	— —	— —	— —	1,064 —	— 595	1,659
May	European Chinese	1,064 —	— 595	— —	— —	— —	— —	1,064 —	— 595	1,659
June	European Chinese	1,064 —	— 901	— —	— —	— —	— —	1,064 —	— 901	1,965
July	European Chinese	1,064 —	— 1,105	— —	— —	— —	— —	1,064 —	— 1,105	2,169
August	European Chinese	1,102 —	— 1,158	— 125	— —	— —	— —	1,102 —	— 1,283	2,385
September	European Chinese	1,102 —	— 1,358	— 125	— —	— —	— —	1,102 —	— 1,483	2,585
October	European Chinese	1,102 —	— 1,548	— 125	— —	— —	— —	1,102 —	— 1,673	2,775
November	European Chinese	1,102 —	— 1,541	— 125	— —	— —	— —	1,102 —	— 1,666	2,768
December	European Chinese	1,102 —	— 1,496	— 160	— —	— —	— —	1,102 —	— 1,656	2,758

NOTE.—Hydraulic horse power includes hydraulic elevators and monitors.

TABLE 30F.

ACTIVE HORSE POWER ON MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF TRENGGANU.

End of Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Underground.	Miscellaneous.	TOTAL.		Grand Total.
								European Mines.	Chinese Mines.	
January	European Chinese	—	1,017	—	—	52	210	—	1,279	1,279
February	European Chinese	—	1,047	—	—	31	140	—	1,218	1,218
March	European Chinese	—	1,045	—	—	30	210	—	1,285	1,285
April	European Chinese	—	1,045	—	—	30	—	—	1,075	1,075
May	European Chinese	—	1,045	—	—	30	—	—	1,075	1,075
June	European Chinese	—	1,045	—	—	30	—	—	1,075	1,075
July	European Chinese	—	950	5	—	61	65	—	1,081	1,081
August	European Chinese	—	825	5	1,000	58	65	1,000	953	1,953
September	European Chinese	—	825	5	1,000	58	89	1,000	977	1,977
October	European Chinese	—	1,063	—	2,370	30	—	2,370	1,093	3,463
November	European Chinese	—	1,338	10	2,370	30	—	2,370	1,378	3,748
December	European Chinese	—	1,104	10	2,370	30	—	2,370	1,144	3,514

NOTE.—Hydraulic horse power includes hydraulic elevators and monitors.

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TABLE 30G.

ACTIVE HORSE POWER ON MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF KEDAH.

End of Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Underground.	Miscellaneous.	TOTAL.		Grand Total.
								European Mines.	Chinese Mines.	
January	European Chinese	405 —	— 465	—	—	—	—	405 —	— 465	870
February	European Chinese	405 —	— 465	—	—	—	—	405 —	— 465	870
March	European Chinese	405 —	— 225	—	—	—	—	405 —	— 225	630
April	European Chinese	405 —	— 465	— 70	—	—	—	405 —	— 535	940
May	European Chinese	495 —	— 340	— 70	—	—	—	495 —	— 410	905
June	European Chinese	495 —	— 300	— 50	—	—	—	495 —	— 350	845
July	European Chinese	495 —	— 444	—	—	—	—	495 —	— 444	939
August	European Chinese	495 —	— 534	—	—	—	—	495 —	— 534	1,029
September	European Chinese	495 —	— 534	—	—	—	—	495 —	— 534	1,029
October	European Chinese	495 —	— 484	—	—	—	—	495 —	— 484	979
November	European Chinese	495 —	— 604	—	—	—	—	495 —	— 604	1,099
December	European Chinese	495 —	— 604	—	—	—	—	495 —	— 604	1,099

NOTE.—Hydraulic horse power includes hydraulic elevators and monitors.

TABLE 30H.
ACTIVE HORSE POWER ON MINES, 1948, BY STATES AND METHODS OF MINING.

STATE OF PERLIS.

End of Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Underground.	Miscellaneous.	TOTAL.		Grand Total.
								European Mines.	Chinese Mines.	
January	European Chinese	—	—	—	—	94	—	—	94	94
February	European Chinese	—	24	—	—	230	—	—	374	374
March	European Chinese	—	—	—	—	651	—	—	651	651
April	European Chinese	—	—	100	—	811	—	—	911	911
May	European Chinese	—	—	100	—	948	—	—	1,048	1,048
June	European Chinese	—	—	100	—	948	—	—	1,048	1,048
July	European Chinese	—	226	100	—	1,008	—	—	1,334	1,334
August	European Chinese	—	132	100	—	1,708	—	—	1,940	1,940
September	European Chinese	—	—	100	—	1,733	—	—	1,833	1,833
October	European Chinese	—	226	100	—	1,848	—	—	2,174	2,174
November	European Chinese	—	226	100	—	2,071	—	—	2,397	2,397
December	European Chinese	—	226	100	—	2,071	—	—	2,397	2,397

NOTE.—Hydraulic horse power includes hydraulic elevators and monitors.

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TABLE 301.
ACTIVE HORSE POWER ON MINES, 1948, BY STATES AND METHODS OF MINING.
STATE OF MALACCA.

End of Month.	Mine.	Dredging.	Gravel Pumping.	Hydraulic.	Open Cast.	Underground.	Miscellaneous.	TOTAL.		Grand Total.
								European Mines.	Chinese Mines.	
January	European Chinese	—	725	—	50	—	—	—	775	775
February	European Chinese	—	725	—	50	—	—	—	775	775
March	European Chinese	—	725	—	50	—	—	—	775	775
April	European Chinese	—	725	—	50	—	—	—	775	775
May	European Chinese	—	725	—	50	—	—	—	775	775
June	European Chinese	—	725	—	50	—	—	—	775	775
July	European Chinese	—	758	—	50	—	—	—	808	808
August	European Chinese	—	938	—	50	—	—	—	1,038	1,038
September	European Chinese	—	1,013	—	50	—	—	—	1,063	1,063
October	European Chinese	—	1,013	—	50	—	—	—	1,063	1,063
November	European Chinese	—	1,038	—	50	—	—	—	1,088	1,088
December	European Chinese	—	1,080	—	50	—	—	—	1,130	1,130

NOTE.—Hydraulic horse power includes hydraulic elevators and monitors.

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VI.—MINING LAND.

PROSPECTING.

Except on land already alienated prospecting is not allowed except under licences or permits issued by Government. Applications for these are investigated to ensure that subsequent mining would not damage other interests.

From 1929 until the Japanese occupation in 1942 prospecting was also restricted, partly in connection with the International Tin Control Scheme, to an extent which almost certainly did not prove reserves at a rate equivalent to the exhaustion by mining.

After the defeat of the Japanese in 1945 a Moratorium was placed on dealings in land, with the result that very little prospecting was allowed until late in 1947 when applications could again be entertained.

A large number of prospecting applications have been received during the year, and a fair amount of prospecting was carried out prior to the commencement of the emergency in July last; but since that time prospecting has practically ceased except in areas which are easily accessible and are considered "safe".

It is certain that much prospecting will be done as soon as conditions permit, and it is evident that new mining areas will have to be located unless mining is to be severely restricted in the not too distant future.

TABLE 31.

Year.	No. of licences or permits issued.	Acreage.	No. of selections.	Acreage.
1929	72 ..	93,596 ..	39 ..	5,815 ..
1930	17 ..	15,224 ..	7 ..	1,047 ..
1931	17 ..	70,781 ..	2 ..	15 ..
1932	41 ..	188,158 ..	2 ..	65 ..
1933	88 ..	234,189 ..	2 ..	120 ..
1934	69 ..	159,732 ..	16 ..	2,202 ..
1935	57 ..	94,780 ..	18 ..	2,420 ..
1936	122 ..	120,583 ..	43 ..	5,505 ..
1937	183 ..	167,281 ..	55 ..	3,035 ..
1938	232 ..	323,922 ..	81 ..	5,567 ..
1939	204 ..	179,378 ..	64 ..	13,342 ..
1940	203 ..	254,853 ..	75 ..	10,485 ..
1941 (Jan.-Sept.)	128 ..	15,365 ..	41 ..	11,330 ..
1946	13 ..	8,928 ..	2 ..	278 ..

TABLE 32.

PROSPECTING UNDER ALL TYPES OF LICENCES AND PERMITS.

States.	No. of applications in 1947.	No. of licences or permits issued in 1947.	No. of former licences and permits current on 1-1-1947.	Total acreage under licences and permits.*	Total acreage selected for mining leases.†
All States	478 ..	82 ..	19 ..	208,679 ..	949 ..
States.	No. of applications in 1948.	No. of licences or permits issued in 1948.	No. of former licences and permits current on 1-1-1948.	Total acreage under licences and permits.*	Total acreage selected for mining leases.†
Perak	262 ..	37 ..	15 ..	8,594 ..	737 ..
Selangor	141 ..	15 ..	7 ..	9,112 ..	197 ..
Negri Sembilan ..	29 ..	9 ..	4 ..	4,694 ..	106 ..
Pahang	84 ..	31 ..	15 ..	229,983 ..	600 ..
Johore	31 ..	24 ..	12 ..	158,986 ..	4,075 ..
Trengganu	46 ..	18 ..	10 ..	11,726 ..	— ..
Kedah	25 ..	4 ..	3 ..	2,719 ..	— ..
Perlis	1 ..	— ..	1 ..	63 ..	— ..
Kelantan	— ..	— ..	— ..	— ..	— ..
Malacca	5 ..	1 ..	2 ..	3,996 ..	— ..
Totals	624 ..	139 ..	69 ..	429,873 ..	5,715 ..

* Many of these licences and permits are still extant, where prospecting has been completed.

† Total acreage selected refers only to areas

JANUARY TO DECEMBER, 1948.

TABLE 33.

FOREST PERMITS.

States.	No. of applications in 1947.	No. of permits issued in 1947.	No. of former permits current on 1-1-1947.	Total acreage under permits.*	Total acreage selected for mining leases.†
All States	39	10	3	20,734	1,695
States.	No. of applications in 1948.	No. of permits issued in 1948.	No. of former permits current on 1-1-48.	Total acreage under permits.*	Total acreage selected for mining leases.†
Perak	59	—	1	600	—
Selangor	20	7	5	11,819	80
Negri Sembilan ..	5	—	—	—	—
Pahang	5	3	—	12,927	—
Johore	4	3	—	832	140
Tromgganu	2	1	—	1,696	—
Kedah	14	3	—	450	43
Perlis	—	—	—	—	—
Kelantan	—	—	—	—	—
Malacca	—	—	—	—	—
Totals	109	17	6	28,324	263

ACREAGE OF MINING LAND.

The following figures cover only Perak, Selangor, Negri Sembilan and Pahang, and exclude a total of 194,153 acres under concession in Pahang.

TABLE 34.

Year.	Total acreage.	Year.	Total acreage.
1929 ..	196,409	1937 ..	201,841
1930 ..	197,731	1938 ..	207,344
1931 ..	193,456	1939 ..	212,273
1932 ..	189,149	1940 ..	223,601
1933 ..	191,352	1941 ..	227,936
1934 ..	193,299	1946 ..	227,321
1935 ..	195,086	1947 ..	542,159
1936 ..	198,050	1948 ..	538,912

Compared with the above area of under $\frac{1}{2}$ million acres of mining land, there were 7 million acres of Forest Reserves and over $3\frac{1}{2}$ million acres of Malay Reserves.

Mining land in the Federation of Malaya, including concessions, at the end of 1948 totalled 538,912 acres.

* Many of these licences and permits are still extant.
where prospecting has been completed.

† Total acreage selected refers only to areas

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VII.—EXPORT DUTIES AND ROYALTIES ON MINERALS.

Description of article.

Minerals, Metals and Metalliferous Ores —

1. Tin-ore :

- | | |
|---|--|
| (i) When the price of tin does not exceed \$41 (per picul) | \$2.40 per picul. |
| (ii) When the price of tin exceeds \$41 but does not exceed \$42 | \$2.52 per picul. |
| (iii) When the price of tin exceeds \$42 but does not exceed \$43 and so on, the duty per picul being increased by 12 cents per every dollar by which the price of tin exceeds \$41 | \$2.64 per picul. |
| (iv) Tin, smelted or manufactured from tin-ore won in the Federation of Malaya unless smelted in the free port of Penang | On the same scale as that for tin-ore, together with an additional duty of one-third of the duty on tin-ore. |
| (v) Tin slag and hard-head of tin | At the rate prescribed for tin-ore, unless the consignment is accompanied by a certificate of assay granted by the Government Geologist or approved by the Senior Inspector of Mines, in which case the duty shall be at the rate prescribed for tin smelted or manufactured on the amount of tin estimated to be contained in such consignment. |
| *(vi) To be smelted elsewhere than in Singapore or the free port of Penang | In the case of tin-ore exported otherwise than under such guarantees as the High Commissioner may require that it shall be smelted in Australia or the United Kingdom, an additional duty of \$30 per picul. |
| 2. Scheelite and Wolfram | \$2 per picul. |
| 3. Gold | 5 per cent. <i>ad valorem</i> at \$66 per oz. <i>vide</i> G.N. 4414 of 1939 (F.M.S.) |
| 4. Coal | 25 cents per ton. |
| 5. China-clay or Kaolin | 75 cents per ton. |
| 6. Other metals and metalliferous ores | 10 per cent. <i>ad valorem</i> . |

* Deleted from Table B, Export Duties III (a) of the Customs Enactment, 1936, as from 30th June, 1948, G. N. No. 1704 dated 1st July, 1948.

TABLE 35.
VIII.—WORLD STATISTICS.
FOREIGN IMPORTS OF TIN-ORE INTO MALAYA.

The following table indicates foreign imports of tin-ore into Malaya for smelting by either the Straits Trading Co. at Singapore or the Eastern Smelting Co. at Penang.

(Tons.)

Year.	Alaska.	Burma.	Banks and Biliton.	Singkep.	Other places.	French Indo-China.	Japan.	Siam.	Tanganyika.	Union of South Africa.	Uganda.	Australia.	China.	Belgian Congo.	Kenya.	British East Africa.	Total.
1929	39	1,672	20,173	1,403	—	584	127	9,939	—	1,188	—	—	—	—	—	—	85,126
1930	53	1,917	24,881	1,924	33	1,053	447	15,361	—	1,011	—	—	—	—	—	—	46,690
1931	24	2,104	19,598	1,852	41	1,045	841	17,377	3	578	—	4	1	—	—	—	43,563
1932	5	2,470	9,088	757	7	1,730	811	12,679	75	883	—	—	—	—	—	—	28,455
1933	—	2,845	1,486	592	34	1,811	790	14,806	124	1,148	2	—	—	—	—	—	23,142
1934	2	3,415	—	—	32	1,951	881	14,454	111	993	73	47	2	—	—	9	21,970
1935	75	4,121	—	—	51	2,433	280	13,595	150	997	160	122	48	—	—	—	22,082
1936	14	4,213	—	—	58	2,373	692	17,627	278	1,228	171	64	210	10	—	—	26,984
1937	—	4,304	—	—	28	2,443	940	22,295	202	663	35	—	267	—	2	—	31,160
1938	—	4,444	—	—	28	2,592	838	18,030	51	277	—	—	607	—	—	—	27,765
1939	—	5,063	9,852	900	23	2,176	58	22,961	6	212	—	—	282	—	91	—	41,624
1940	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	62,352
1941 (Jan. to Oct.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	48,407
1942 to 1946	—	—	—	—	—	—	—	NOT AVAILABLE.	—	—	—	—	—	—	—	—	—
1947	—	1,725	2	—	106	—	—	2,726	—	—	—	—	—	—	—	—	4,559
1948	—	2,615	2	—	—	44	—	2,287	—	—	—	—	—	—	—	—	4,848

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TABLE 36.

DESTINATION OF STRAITS SHIPMENTS.

Tons Tin.

Year.	United Kingdom.	United States of America.	Continent of Europe.	British Possessions.	Japan.	The Netherlands Indies.	Other Foreign Countries.	Total.
1929	15,395	57,696	20,619	4,993	2,045	—	1,273	102,026
1930	9,398	57,869	22,160	4,929	1,556	—	1,092	97,004
1931	11,508	49,293	16,128	4,544	1,979	—	252	83,704
1932	5,936	19,947	16,386	3,117	2,259	—	263	47,903
1933	2,655	31,132	15,371	2,557	1,868	28	320	53,931
1934	4,703	26,683	12,446	3,036	2,780	36	302	50,186
1935	4,080	40,408	10,191	4,759	2,500	49	261	62,248
1936	5,589	59,106	10,703	4,524	3,179	35	356	83,492
1937	7,319	64,462	10,475	5,254	5,192	29	375	93,106
1938	4,230	33,652	9,412	4,696	8,543	18	636	61,187
1939	560	56,796	9,116	6,141	8,388	42	1,051	82,089
1940	—	—	—	—	—	—	—	130,935
1941 (Jan.-Oct.) ..	—	—	—	—	—	—	—	108,896
1942	—	—	—	—	—	—	—	9,600
1943	—	—	—	—	—	—	—	16,700
1944	—	—	—	—	—	—	—	4,000
1945	—	—	—	—	—	—	—	3,000
1946	—	—	—	—	—	—	—	7,280
1947	335	17,500	6,655	7,449	—	7	126	32,072
1948	155	29,497	7,273	9,746	—	—	543	47,214

Sources of information: 1929-1938 The Statistical Year Book 1939 of the International Tin Research and Development Council.

1939-1941 Malaya.

1942-1946 The Statistical Bulletin of the International Tin Study Group.

1947-1948 The Registrar of Malayan Statistics.

TABLE 37.
WORLD'S PRODUCTION OF TIN-IN-ORE.
LONG TONS.

Year.	Belgian Congo.	Nigeria.	Bolivia.	Burma.	China.	French Indo- China.	Malaya.	Indonesia.	Siam.	United Kingdom.	Other Countries.	World.
1935 ..	5,301	6,557	27,16*	3,030	9,39*	1,310	42,375	20,185	9,876	2,050	9,200	138,000
1936 ..	6,301	9,78*	24,07*	3,320	10,66*	1,381	66,769	30,729	12,678*	2,000	9,600	170,000
1937 ..	8,942	10,782	25,025	3,345	10,457	1,577	77,266	39,134	16,424†	1,983	10,000	207,500
1938 ..	8,820	8,077	25,371	3,20*	11,246	1,509	43,375	27,298	14,704	2,010	11,400	160,000
1939 ..	8,964	9,42*	27,215	3,833	10,850	1,474	47,416	27,890	16,970†	1,632	10,600	167,000
1940 ..	12,482	12,012	37,940	5,359	6,240	1,475	83,000*	42,867	17,447†	1,619	11,200	231,500
1941 ..	16,190	12,035	42,050	6,593	5,000*	1,205	79,400*	51,000*	15,247†	1,509	10,800	239,000
1942 ..	16,191	12,406	38,291	1,100*	4,400	1,029	15,748	9,933	7,633	1,363	11,400	119,500
1943 ..	17,480	12,696	41,523	1,100*	3,200	653	26,000	17,632	5,340	1,359	10,700	138,500
1944 ..	17,326	12,512	38,809	700*	3,300	358	9,309	6,753	3,206	1,289	7,700	101,000
1945 ..	17,077	11,230	42,483	300*	3,500	86	8,152	948	1,775	1,152	8,600	80,500
1946 ..	14,091	10,338	37,619	245	1,320	—	8,432	6,460	1,066	798	8,300	80,000
1947 ..	14,897	9,139	33,259	1,818	4,000*	—	27,026	15,915	1,401	895	6,300	114,600
1948 ..	14,073	9,234	37,309	—	—	—	44,815	30,565	—	1,281	—	—
1948 January ..	1,165	900	2,468	91	100*	—	3,331	1,913	272	86	440	11,100
February ..	1,110	789	2,822	116	400*	—	3,001	1,956	234	86	450	11,000
March ..	1,478	731	3,395	110	400*	—	3,456	2,554	263	135	430	13,000
April ..	932	703	2,670	94	400*	—	3,518	2,463	313	189	450	11,700
May ..	1,522	647	3,116	108	400*	—	3,758	2,726	338	89	440	13,100
June ..	1,324	674	2,918	103	400*	—	3,672	2,414	355	94	480	12,200
July ..	756	806	3,276	110*	400*	—	3,075	2,543	386	142	470	12,700
August ..	949	724	2,502	110*	400*	—	3,851	2,585	386	105	430	13,300
September ..	1,452	824	3,204	110*	400*	—	4,012	2,726	437	83	450	13,400
October ..	868	880	3,425	110*	400*	—	4,153	3,090	482	130	430	14,300
November ..	1,047	708	3,098	110*	400*	—	4,268	3,033	400*	94	440	14,000
December ..	872	831	4,415	110*	400*	—	—	—	—	—	—	—
Total ..	14,073	9,234	37,309	—	—	—	44,815	30,565	—	1,281	—	—

* Estimated. † Exports as production figures are not available.
Source : From the Statistical Bulletin of the International Tin Study Group, Vol. II, No. 2.

TABLE 38.
WORLD'S APPARENT CONSUMPTION OF TIN.
LONG TONS

Year.	U.S.A.	United Kingdom.	Germany.	France.	Italy.	U.S.S.R.	Japan.	Other Countries.	World.
1935	62,470	21,427	11,083	8,211	6,641	7,311	6,221	25,886	149,200
1936	68,232	21,860	9,164	9,721	3,929	9,664	6,403	25,927	154,000
1937	72,928	25,971	12,368	9,176	3,601	25,125	8,190	27,841	185,200
1938	48,116	18,290	13,474	9,118	4,649	16,174	10,963	27,816	148,600
1939	66,583	27,279	11,000*	7,726	3,716	2,124	11,184	28,488	158,100
1940	72,324	29,225	2,560	11,785	3,942	1,897	10,800	25,667	158,200
1941	103,086	30,000*	1,600	945	1,575	—	9,500	22,694	169,400
1942	56,282	23,478†	1,700	—	1,903	9,193	11,000	11,338	114,900
1943	46,253	17,631†	1,840	34	1,687	11,990	13,000	9,065	101,500
1944	59,156	18,435†	100	—	—	1,200	11,000	11,209	101,100
1945	55,642	16,396†	—	3,171	—	5,467	3,150	13,892	97,700
1946	54,627	25,606†	—	5,500*	660*	1,474	—	21,433	109,300
1947	63,078	27,384†	904*	9,931*	1,980	—	1,923*	31,695	136,900

* Estimated. † Ministry of Supply showing real consumption.
Source: Statistical Bulletin of the International Tin Study Group, Vol. II, No. 2.

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TABLE 39.
TIN STOCKS AT END OF YEARS.
(Estimated.)
LONG TONS OF TIN CONTENT.

	1935.	1936.	1937.	1938.	1939.	1940.	1941.	1942.	1943.	1944.	1945.	1946.	1947.
<i>Stocks of tin-in-ore.</i>													
Belgian Congo	—	—	—	—	—	—	—	—	—	—	1,721	1,000	1,091
Bolivia	—	—	—	—	—	—	—	—	—	—	9,273	6,856	6,093
U.S.A.	—	—	—	—	—	—	23,245	36,725	40,303	41,097	32,536	24,642	19,634
Malaya (4)	3,020	4,397	5,650	4,511	6,767	—	—	—	—	—	6,200	3,600	5,220
Indonesia	—	—	—	—	—	—	—	—	—	—	3,500	5,000	5,300
Belgium	66	468	217	380	183	—	—	—	—	—	—	2,400	1,443
Netherlands	945	1,170	2,211	2,051	790	—	—	—	—	—	—	—	2,000
United Kingdom	3,286	2,273	6,106	5,854	4,962	9,617	11,400	5,936	10,014	4,834	7,322	8,947	6,357
Other Countries	—	—	—	—	—	—	—	—	—	—	5,200	6,200	2,100
Total (1)	7,317	8,308	14,274	12,796	12,702	9,617	34,645	42,661	50,317	45,931	65,752	58,645	49,242
<i>Tin-in-ore afloat</i>													
to U.S.A.	—	—	—	—	—	—	—	—	—	—	—	800	3,525
to Belgium	—	—	—	—	—	—	—	—	—	—	—	—	628
to Netherlands	—	—	—	—	—	—	—	—	—	—	—	1,950	—
to United Kingdom	—	—	—	—	—	—	7,240	6,808	1,415	6,959	3,943	2,969	2,458
to Malaya	—	—	—	—	—	—	—	—	—	—	—	—	330
Total (1)	—	—	—	—	—	—	7,240	6,808	1,415	6,959	3,943	5,719	6,941
<i>Stocks of tin metal</i>													
(including transit in the country and exclusive consumers stocks.)													
Belgian Congo	—	—	—	—	—	—	—	—	—	—	1,656	177	393
U.S.A. (3)	2,312	5,095	6,385	5,157	3,302	13,371	42,606	56,548	40,675	29,037	28,666	27,014	24,555
Malaya	1,023	2,122	4,388	6,947	6,394	3,472	—	—	—	—	4,300	8,200	4,711
Indonesia	—	—	—	—	—	—	—	—	—	—	4,500	700	—
Belgium	610	247	803	1,576	801	—	—	—	—	—	—	1,200	1,415
Netherlands	548	893	1,714	1,849	2,050	—	—	—	—	—	—	600	2,500
United Kingdom	2,633	4,095	4,240	15,089	5,978	7,457	13,388	14,779	17,542	18,208	23,780	7,779	6,188
Other Countries	—	—	—	—	—	—	—	—	—	—	17,500	17,500	2,700
Total (1)	7,126	12,452	17,530	30,618	18,531	24,300	55,994	71,327	58,217	47,845	80,402	63,170	42,432

TABLE 39—(cont.)
 TIN STOCKS AT END OF YEARS—(cont.)
 (Estimated.)—(cont.)
 LONG TONS OF TIN CONTENT—(cont.)

	1935.	1936.	1937.	1938.	1939.	1940.	1941.	1942.	1943.	1944.	1945.	1946.	1947.
<i>Visible consumers stock of tin metal.</i>													
U.S.A.	7,790	10,240	17,680	17,851	21,111	57,204	58,470	32,852	23,766	17,414	14,951	14,837	14,438
United Kingdom	—	—	—	2,250	2,250	3,000	3,251	2,620	2,387	2,023	2,136	3,683	3,016
Other Countries	—	—	—	—	—	—	—	—	—	—	3,000	7,100	5,900
Total (1)	7,790	10,240	17,680	20,101	23,361	60,204	61,721	35,472	26,153	19,437	20,137	25,620	23,354
<i>Tin metal afloat.</i>													
to U.S.A.	6,730	9,687	6,185	3,007	11,764	22,627	15,000	—	—	—	17	1,655	4,571
to Belgium	1,998	3,615	4,366	3,027	7,410	2,051	—	—	—	—	—	200	261
to Other Countries	—	—	—	—	—	—	—	—	—	—	—	2,670	500
Total (1)	8,728	13,302	10,551	6,034	19,174	24,678	15,000	—	—	—	17	4,525	5,332
GRAND TOTAL													
Belgian Congo	—	—	—	—	—	—	—	—	—	—	3,377	1,177	1,454
Bolivia	—	—	—	—	—	—	—	—	—	—	9,273	6,856	6,093
U.S.A. (3)	16,832	25,022	30,250	26,015	36,177	93,202	139,321	126,125	104,744	88,148	76,170	68,148	66,727
Malaya	4,043	6,519	10,038	11,458	13,161	3,472	—	—	—	—	10,500	11,300	10,261
Indonesia	—	—	—	—	—	—	—	—	—	—	8,000	5,700	5,300
Belgium	676	715	1,020	1,956	984	—	—	—	—	—	—	4,500	3,747
Netherlands	1,493	2,063	3,925	3,900	2,846	—	—	—	—	—	—	2,550	4,500
United Kingdom	5,919	6,368	10,436	23,193	13,190	20,074	35,279	30,143	31,358	32,024	37,231	23,378	18,058
Other Countries (2)	1,998	3,615	4,366	3,027	7,410	7,000	6,000	9,000	24,000	25,000	25,700	33,500	11,200
Total (1)	31,000	44,300	60,000	69,500	73,800	123,700	180,600	165,800	160,100	145,200	170,300	157,600	127,800

(1) Totals only of figures stated.

(2) Inclusive of Siamese and Japanese stocks.

(3) Exclusive of Munitions Board stocks and inclusive of quantities of tin from Japan not yet allocated in the years 1946 and 1947.

(4) Including stocks at mines.

(5) Including visible consumers stock.

(6) Not including Bolivian (at ports).

Source: From the Statistical Bulletin of the International Tin Study Group, Vol. II, No. 2.

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